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CASE REPORT

Variation of Hemoglobin Detection for Lipemic Blood Samples

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SUMMARY

Background: **Blood status is closely related to the hemoglobin test results in clinical laboratory. This paper discusses a case of which hemoglobin test results were not interfered by the "milky" blood status.**
Methods: **Complete Blood Count with Differential (CBC + Diff) was detected for these two specimens with a Sysmex XN-9000.**
Results: **The results of red cell indices for patient I were as follows: red blood cell count (RBC), 5.10 x 10^{12}/L; hematocrit (HCT), 0.455 L/L; hemoglobin (HGB), 167 g/L; mean corpuscular hemoglobin concentration (MCHC), 367 g/L, and triglycerides (TG), 1.59 mmol/L. There was no "turbidity" warning message. However, there was a "turbidity" warning message for patient II and his red cell indices were RBC, 4.74 x 10^{12}/L; HCT, 0.492 L/L; HGB, 182 g/L; MCHC, 370 g/L, and TG, 12.98 mmol/L. After the plasma exchange, there was no "turbidity" warning message for patient I and his red cell indices were RBC, 4.83 x 10^{12}/L; HCT, 0.444 L/L; HGB, 164 g/L; MCHC, 369 g/L which were consistent with the results before the plasma exchange. For patient II, the "turbidity" warning message disappeared and his results were RBC, 3.87 x 10^{12}/L; HCT, 0.398 L/L; HGB, 135 g/L; MCHC, 339 g/L.**
Conclusions: **Our case provided an explanation of the normal hemoglobin detection results in the visible lipemic specimen for the first time.**
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KEY WORDS

turbidity, hemoglobin, lipemia

INTRODUCTION

Two lipemic venous blood specimens were collected respectively from a 51-year-old man diagnosed with left upper lobe lung cancer, named patient I, and a 46-year-old man diagnosed with sigmoid colon cancer, named patient II (Figure 1A). Complete Blood Count with Differential (CBC + Diff) was detected for these two specimens with a Sysmex XN-9000. The results of red cell indices for patient I were as follows: red blood cell count (RBC), 5.10 x 10^{12}/L [reference interval (ref), 4.0 - 5.5]; hematocrit (HCT), 0.455 L/L (ref, 0.40 - 0.54); hemoglobin (HGB), 167 g/L (ref, 120 - 160); mean corpuscular hemoglobin concentration (MCHC), 367 g/L

(ref, 320 - 360) (Figure 1B), and triglycerides (TG), 1.59 mmol/L (ref, 0.45 - 1.69). There was no "turbidity" warning message. However, there was a "turbidity" warning message for patient II and his red cell indices were RBC, 4.74 x 10^{12}/L; HCT, 0.492 L/L; HGB, 182 g/L; MCHC, 370 g/L (Figure 1B), and TG, 12.98 mmol/L (ref, 0.45 - 1.69).

To ensure the accuracy of the results for these two specimens, plasma exchange procedure was performed with diluents for both samples and then the test was repeated with the same analyzer. After the plasma exchange, there was no "turbidity" warning message for patient I and his red cell indices were RBC, 4.83 x 10^{12}/L; HCT, 0.444 L/L; HGB, 164 g/L; MCHC, 369 g/L which were consistent with the results before the plasma exchange (Figure 1B). For patient II, the "turbidity" warning message disappeared and his results were RBC, 3.87 x 10^{12}/L; HCT, 0.398 L/L; HGB, 135 g/L; MCHC, 339 g/L (Figure 1B). The MCHC result was observed obviously decreased after the plasma exchange. Both venous blood specimens were severely lipemic. Patient I was correctly detected by Sysmex XN-9000 before the plasma exchange. However, the results of patient II were interfered by lipemia but could be corrected after the plasma exchange.

Questions to consider:

1. What are the common causes associated with the "milky" blood, especially in tumor patients?
2. What is the possible reason for one sample with no "turbidity" warning message even though both specimens were same severely lipemic?
3. What is the standard operating procedure for the lipemic blood specimen?

DISCUSSION

Lipemia refers to a higher amount of fat in the blood. This type of blood has milky appearance and can be visually observed. The mechanism of lipemia interference with HGB measurement is mainly due to the increase of insoluble substance, which makes the specimen turbid, the transparency of the specimen is decreased, the incident light scattered, and thereby affects the absorbance of the chemical reaction or the change of the product color [1]. It can occur in patients with hyperlipidemia and patients with fat emulsion [2]. Hyperlipidemia can be found in many diseases, such as atherosclerosis, diabetes, and colorectal cancer [3]. Fat emulsion is in common use in patients with wasting diseases, such as cancer. Furthermore, many medications disturb the determination of analytes [4]. Metabolites of drugs may cause interferences and they are as important as the parent drug to consider.

High triglycerides (TG) in blood, which contains chylomicrons (CMs) and very low density lipoprotein (VLDL) particles, is a well-known factor that can interfere with the measurement of hemoglobin (HGB) using automated hematology analyzers [5]. It can cause falsely high HGB values [4]. According to the complaint from patient II and the TG results in our hospital (Figure 1C), we believe the blood sample from the patient II is a "true" lipemic sample. The HGB value is falsely high, and it can be corrected with plasma exchange as we already know (Figure 1B). The infusion of fat emulsion in cancer hospitals is also a common practice, which causes lipemic blood and falsely high HGB result. Bornhost's report [6] had shown that samples with added intralipid could not fully simulate native lipemia samples. Su-Gen Zeng et al. [5] offered a correction method which worked well in clinical practice, especially for those patients who received intralipid injection. However, the lipemic sample from patient I presented the same HGB results before and after plasma exchange. Based on the complaint of patient I and historical TG data, we suppose the lipemic blood sample from the patient I is a "false" lipemic sample, which may be caused by some medicines or their derivatives that can be dissolved by the hemolytic agent SULFOLYSER (SYSMEX Corporation). This kind of "false" lipemic samples are common in cancer hospitals because of the complex medication for tumor patients, such as chemotherapeutic drugs or injection to increase leukocyte count.

Different concentrations of lipemia may affect HGB measurement to different degrees. Severe lipemia can have a dramatic impact on hemoglobin related parameters, some samples possibly cannot be measured in some cases. It is a big challenge for laboratory. When testing blood samples with lipemia, the inspectors should not only fully understand the mechanism of interference and select appropriate procedures to eliminate it, but also need to actively communicate with doctors to confirm the root cause of lipemia and advise doctors to take corrective action. So far there are many methods to eliminate lipemia interference, such as plasma exchange method, physiological saline dilution method, high speed centrifugation method, freezing high speed centrifugation method, vacuum high-speed centrifugation method, phosphotungstic acid-magnesium method, polyethylene glycol method, ether extraction method, LipoClear® reagent, etc. [7-10]. Among them, the plasma exchange method has the advantages of strong anti-interference capability, easy operation, low cost, and high efficiency [10], which can meet the various requirements for clinical laboratory in general hospitals.

CONCLUSION

We expect a standard operating procedure of hemoglobin measurement for lipemic samples can be established in the future.

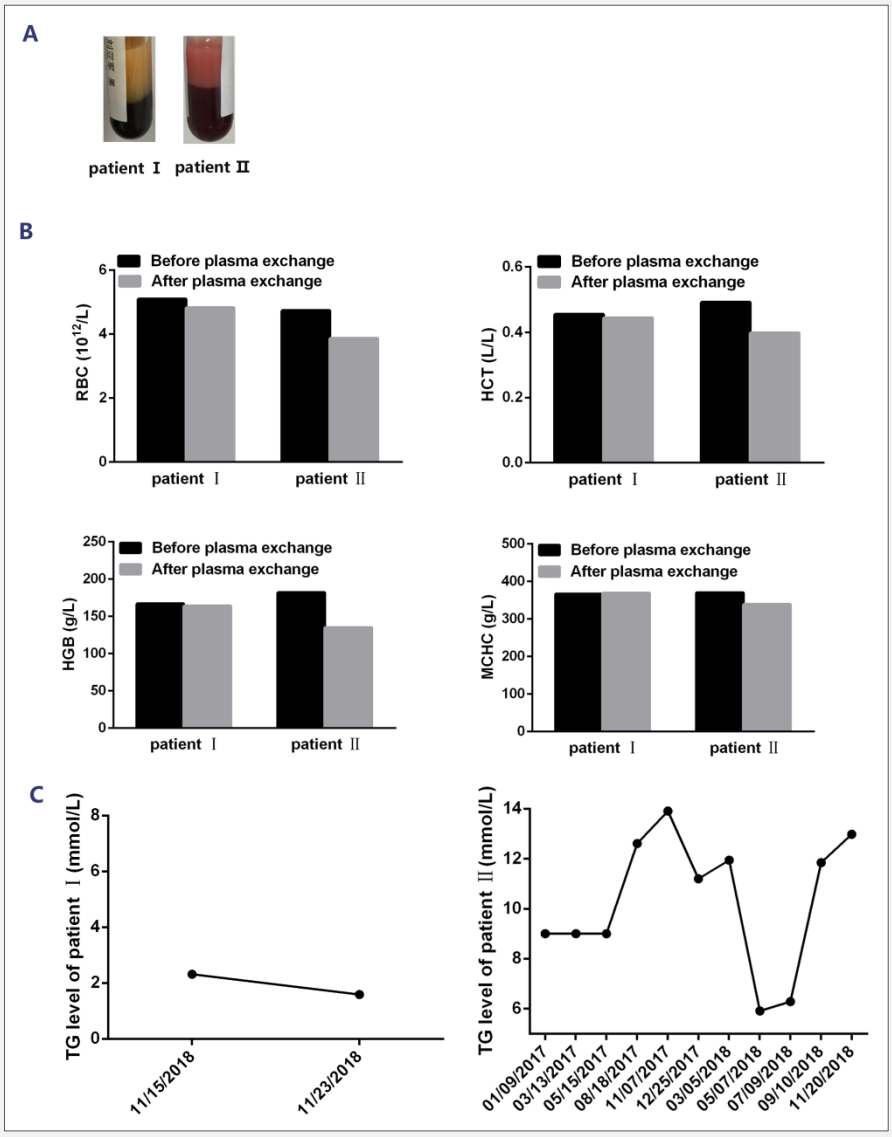

Figure 1. Different interference with hemoglobin measurement on lipemic blood samples.

(A) The appearance of the two lipemic bloods.
(B) The red cell indices of the two patients before and after plasma exchange.
(C) TG records of the two patients in our hospital.

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Declaration of Interest:
We declare no conflicts of interest.

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