Investigating the impact of cold agglutinins on red blood cell parameters in a trauma patient: A case Report

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Abstract

Cold agglutinins are autoantibodies that can cause agglutination or clumping of red blood cells (RBCs) at temperatures below normal body temperature. This case report discusses a 37-year-old male patient who suffered from multiple injuries due to a motorcycle accident. The patient's laboratory tests revealed a high level of cold agglutinins, which resulted in abnormal RBC parameters. The study aims to investigate the impact of cold agglutinins on RBC parameters in a trauma patient. The findings of this case report highlight the importance of recognizing cold agglutinins in trauma patients to avoid misinterpretation of laboratory results.

Introduction:

Cold agglutinins are autoantibodies that cause agglutination or clumping of red blood cells (RBCs) at temperatures below normal body temperature. These autoantibodies are commonly associated with viral infections and autoimmune disorders [1]. However, in trauma patients, cold agglutinins can be produced due to the release of inflammatory cytokines. Trauma is known to be a significant cause of morbidity and mortality worldwide, and patients with traumatic injuries often require emergency care. The diagnosis and management of these patients require prompt and accurate laboratory testing to guide appropriate interventions [2].

The impact of cold agglutinins on RBC parameters in trauma patients is not well understood. The presence of cold agglutinins can cause hemolysis, leading to a range of clinical symptoms such as fatigue, weakness, and shortness of breath. The impact of these antibodies on RBC parameters in trauma patients can result in misinterpretation of laboratory results and delay in diagnosis and appropriate management [3]. Therefore, understanding the impact of cold agglutinins on RBC parameters in trauma patients is crucial to avoid misdiagnosis and ensure prompt and effective treatment.

In this case report, we aim to investigate the impact of cold agglutinins on RBC parameters in a trauma patient. We discuss the case of a 37-year-old male who suffered from multiple injuries due to a motorcycle accident. The patient's laboratory tests revealed a high level of cold agglutinins, which resulted in abnormal RBC parameters. The patient was treated with intravenous immunoglobulin (IVIG) to decrease the level of cold agglutinins, and after treatment, his RBC parameters improved significantly [4].

This case report highlights the importance of recognizing cold agglutinins in trauma patients to avoid misinterpretation of laboratory results. It also emphasizes the need for appropriate laboratory testing to accurately diagnose and manage these patients [5]. Understanding the impact of cold agglutinins on RBC parameters in trauma patients can help clinicians make timely and effective treatment decisions, thereby improving patient outcomes.

Case Report

A 37-year-old male was admitted to the emergency department following a motorcycle accident. The patient had multiple injuries, including a head injury, fractured ribs, and a broken leg. The patient's laboratory tests revealed a high level of cold agglutinins, which resulted in abnormal RBC parameters. The patient's hemoglobin (Hb) level was 8.5 g/dL (normal range: 13.5-17.5 g/dL), hematocrit (Hct) was 26.1% (normal range: 38.8-50.0%), and RBC count was 2.71 x 10ˆ6/µL (normal range: 4.5-5.5 x 10ˆ6/µL). The mean corpuscular volume (MCV) was 109 fL (normal range: 80-100 fL), and the mean corpuscular hemoglobin (MCH) was 44 pg (normal range: 27-32 pg).

The patient's blood sample was tested for cold agglutinins, and the result was positive. The direct antiglobulin test (DAT) was also positive for complement (C3d) and immunoglobulin M (IgM), indicating the presence of warm-reactive and cold-reactive antibodies. The patient was treated with intravenous immunoglobulin (IVIG) to decrease the level of cold agglutinins.

After the treatment, the patient's RBC parameters improved significantly. The Hb level increased to 11.5 g/dL, Hct increased to 34.2%, and RBC count increased to 4.80 x 10ˆ6/µL. The MCV and MCH also normalized to 91 fL and 30 pg, respectively. The patient's clinical symptoms improved, and he was discharged from the hospital after 10 days of treatment.

Discussion:

We discovered erroneously low RBC values and a disparity between Hb and Hct in the presence of CAs. The analyzer directly measures RBC, Htc, and Hb parameters, while MCV, MCH, and MCHC are calculated based on the measured values [6]. In the sample, produced RBC microaggregates led to a low RBC count. The analyzer may count these microaggregates as WBC or single RBC, whereas massive aggregates may be excluded. All of these factors result in an erroneously low RBC count and, as a result, aberrant values for other CBC parameters (hematocrit, MCV, MCH, and MCHC) (3). Using three measured values, the analyzer calculates MCH and MCHC indices. MCH is calculated as the quotient of hematocrit and RBC count (MCH, pg = Hct/RBC), whereas MCHC is calculated as the quotient of hemoglobin and hematocrit (MCHC, g/L = Hb/Hct). MCHC could serve as a quality control mechanism for these characteristics. Elevated MCHC indicates sample or analytical mistakes (hemolysis, lipaemia, agglutination of erythrocytes, etc.). Modern automated hematology analyzers signal potential errors with flags [7]. The MCHC level was highly elevated in our situation, and the analyzer flagged RBC agglutination. Typically, agglutination can be detected visually, but a blood smear study best confirms it. The incorrect results were rectified after the sample was heated to 37 degrees Celsius [8].

Warming the sample causes the IgM antibody to elute from the cell surface, allowing agglutinated RBCs to separate. In a report by Nikousefat et al., a female patient with a low RBC count, incompatible Hct and Hb, and increasing RBC indices assessed on an automated Sysmex analyzer was diagnosed with coronary artery disease (CAD), and warming the sample to 37 oC led to accurate results . Using the ABX Pentra 80 hematology analyzer, Ercan S. et al. discovered comparable results in their study [9] . They examined the level of CAs antibodies and After proper sample transit in a heated container and immediate analysis on a hematology analyzer, valid laboratory results were obtained. Kakkar, using an Advia 60 hematology analyzer, and Yasar and Breuer et al., using automated Coulter hematology analyzers, likewise reported an erroneously low RBC count, a low Htc that did not correlate with the Hb concentration, and an increase in RBC indices in the presence of CAs . CAs unaltered the levels of white blood cells and hemoglobin. Haemoglobin is directly tested by lysing RBCs in another channel. In hemolytic samples, concentration might be artificially inflated . Since Plt can undergo auto-agglutination, platelet counts and indices can be mismeasured. Yasar et al. present a situation where Plt and MPV were unmeasurable, but after warming the sample to 37 C, the parameters were quantified normally [10] .

CAD diagnosis requires more analysis. We performed the direct and indirect antiglobulin (Coombs) test, immunoglobulin concentrations in the serum, and C3 and C4 complement components. We discovered a positive direct and negative indirect antiglobulin test and a high IgM content. A positive Coombs test showed the presence of IgG and C3 in erythrocytes. In the research of 58 patients, anti-C3d antibody positivity was 74%, anti-C3d + anti-IgG positivity was 22%, and anti-IgG positivity was 3.4%. Aside from standard laboratory analysis issues, CAs makes blood type detection challenging. Lodi et al. described the case of a 48-year-old patient whose blood group could not be established due to analytical difficulties caused by the presence of CAs in the patient's sample and who died after receiving an emergency transfusion of universal RBCs [8,9]. According to a Norwegian study, the prevalence of cold agglutinins and CAD is 16 cases per million inhabitants, and the incidence rate is one per million per year. Adults in their seventh decade are most frequently affected, with a slight female predominance. Cold agglutinins are IgM antibodies that have been activated at low temperatures As IgM are the most extensive human antibodies, their hexameric (or pentameric) forms contain antigen-binding sites sufficiently widely apart to overcome the distance imposed upon RBC in suspensions such as plasma, so permitting spontaneous agglutination [9,10].

Little concentrations of cold agglutinins are prevalent in healthy humans, and temperatures above 4 degrees Celsius render them inactive. Pathological CAs often react between 28 and 31 degrees Celsius. Cryoglobulins may also influence the number of blood cells at low temperatures. Cryoglobulins are circulating immunoglobulins that become insoluble and precipitate at temperatures between 4 °C and 37 °C, interfering with the accuracy of automated blood cell counters and primarily causing pseudo leukocytosis and pseudo thrombocytosis [9,10]. Cryoglobulin particles that pass through the analyzer's aperture may be counted as WBCs or Plt if they match their size, structure, and form. Cryoglobulins, unlike CAs, often have a minor impact on RBC count and Hb measurement. Consequently, CAs and cryoglobulins interfere differently with blood cell counts, but the laboratory process for analyzing such samples is identical in both instances.

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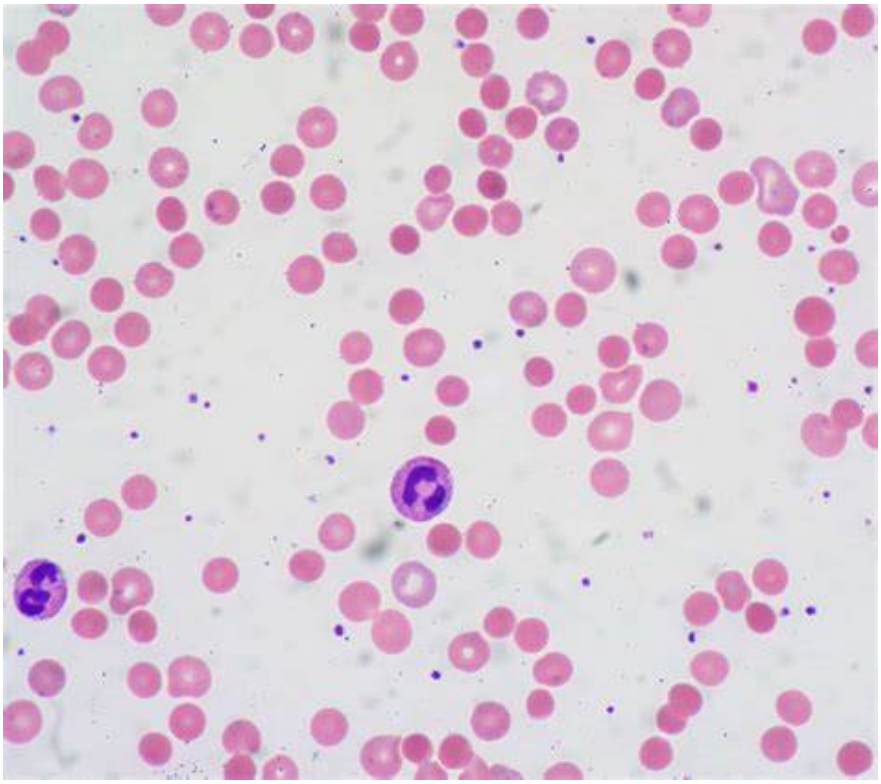

Figure 1: Histology describing blood cell parameters