

# The girl with the iron tattoo

Sophia Fircanis,\* Reve Shields, Jorge Castillo, Anthony Mega and Fred Schiffman

The Warren Alpert Medical School of Brown University; Department of Hematology/Oncology; The Miriam Hospital; Providence, RI USA

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We describe a young woman with profound anemia whose serum iron studies were incongruous with what we expected from iron deficiency anemia. Her high serum iron was not fully explainable until we examined the patient and noticed a large black tattoo on her left flank area. Apparently iron oxide in the ink used for the tattoo was absorbed transcutaneously and led to high serum iron in the face of the other data, which suggested iron deficiency. She was slow in mobilizing her serum iron for erythropoiesis and we discovered that there was a concurrent acute B19 parvovirus infection, which impeded utilization of the iron for red blood cell production. We believe that this case report reinforces the imperative to always do a careful physical examination with any patient who has anemia, and also illustrates the potential toxicity of tattoo ink. The impairment of utilization of the serum iron because of the patient's acute B19 parvovirus infection demonstrates the many consequences of infection induced aplastic anemia.

Parvovirus B19 has only been identified as a causative agent in human disease since 1981, and can present with a wide spectrum of symptomatology, based in part on the host characteristics. In children it can present as a mild febrile illness, and in adults with malaise, muscle aches and arthralgias. In those with underlying hematologic disorders, it can present with aplastic crisis, and in pregnancy, it may manifest with fetal death. We discuss an unusual presentation of the disease in a young patient who proved clinically puzzling for our team.

In March 2010, an 18-year-old woman with a history of menorrhagia presented to our hospital with several months of fatigue and new onset dyspnea on exertion. As the consulting team of hematologists, we were given additional information prior to seeing the patient. Four days prior to presentations, initial anemia workup by her primary caregiver revealed laboratory data which were difficult to reconcile: a complete blood count (CBC) showed hemoglobin (Hb) of 7.0 g/dl with a mean corpuscular volume (MCV) of 57.9 fL. Her white blood cell count (WBC) and platelets were within normal limits.

Reticulocyte production index (RPI) was calculated at 0.63. Serum studies revealed iron of 534 ug/dl, total iron binding capacity (TIBC) of 508 ug/dl, ferritin of 5 ng/ml and transferrin saturation of 105% (Fig. 1).

Upon hospital admission four days later, the patient's Hb was 6.1 g/dl, Hematocrit (Hct) 19.8%, MCV 57.5. Her RPI had fallen to 0.04. Her serum iron level had fallen to 169 ug/dl, TIBC was 471 ug/dl, ferritin increased to 127 ng/ml and transferrin saturation was now 36%. Review of the peripheral blood smear showed hypochromic red blood cells (RBCs) with anisocytosis and poikilocytosis. We were puzzled by the laboratory values in the face of apparent iron deficiency anemia, with elevated serum iron and ferritin.

The patient denied ingesting iron supplements, iron-rich foods or intravenous iron administration. Physical exam revealed stable vital signs, and she was well-appearing with mild conjunctival pallor, no evidence of bleeding and no koilonychia. Skin examination revealed an intricate tattoo on her left flank (Fig. 2A). The patient reported this tattoo had been

applied approximately one week prior to admission, in a licensed tattoo parlor. Due to the reticulocytopenia and puzzling iron values, a bone marrow aspirate was performed. Pathology revealed a hypocellular marrow with marked erythroid hypoplasia and erythroid maturation arrest, consistent with pure red cell aplasia (PRCA) (Fig. 2B). The patient was transfused with two units of packed RBCs and her Hct rose appropriately. PCR for parvovirus B19 was positive at  $4.6 \times 10^9$  copies/ml. Parvovirus IgM index was positive at 8.10 and IgG was negative. Oral iron supplementation was started, and on post discharge follow-up the patient had resolution of her symptoms, anemia and reticulocytopenia (Fig. 1).

We believe our patient suffered from iron deficiency anemia complicated by acute parvovirus B19 infection-associated PRCA, with iron studies suggestive of transdermal uptake of iron from a recently applied tattoo. Black tattoo inks commonly include iron oxide as an ingredient. As defined by the United States Food and Drug Administration, iron oxide is a cosmetic "color additive." As such, it is monitored for content of harmful metals

\*Correspondence to: Sophia Fircanis; Email: sfircanis@lifespans.org  
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	Day -4	Hospital day #1	Post day #7
Complete blood count			
Hemoglobin (g/dl)	7.0	6.1	9.7
Hematocrit (%)	23.6	19.8	30
Reticulocyte Count (%)	3.1	0.2	2.8
Iron studies			
Iron (ug/dl)	534	169	42
TIBC (ug/dl)	508	471	402
Transferrin saturation (%)	104	36	10
Ferritin (ng/dl)	5	127	311

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Tattoo application

Transfusion of 2 units of packed red blood cells

**Figure 1.** Patient's hematologic markers and iron levels from pre-admission to time of follow-up indicating initial poor utilization of iron and eventual recovery.

such as arsenic, lead and mercury, but the content of iron is otherwise not controlled.<sup>1</sup> We believe that this patient had suffered

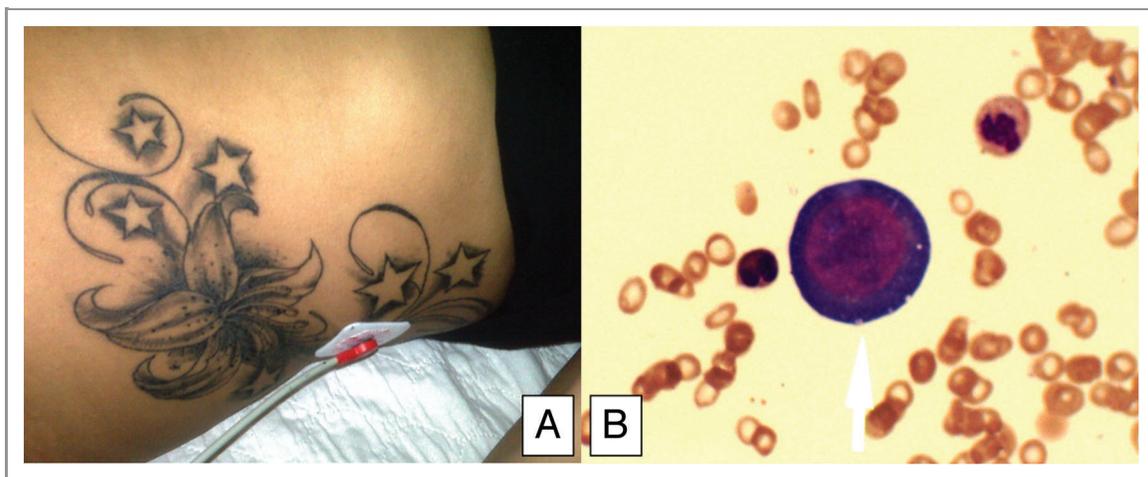
from chronic iron depletion due to her history of menorrhagia,<sup>2</sup> and because of acute PRCA due to parvovirus infection,

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transcutaneous absorption of this iron compound resulted in a high serum iron value. By the time of hospitalization, serum iron level fell, indicating either a transformation into storage iron, or utilization for erythropoiesis. Possibly, the synchronous parvovirus infection prevented excess serum iron from being fully utilized.

While transdermal absorption of dyes and inks does reliably occur, and is commonly used in sentinel node marking,<sup>3,4</sup> transdermal absorption of iron has not been well described in the literature. One case of overwhelming systemic iron intoxication has been reported in a patient that suffered fatal iron absorption through extensive skin burns.<sup>5</sup> Our patient demonstrates that serum iron levels may increase after transcutaneous iron absorption in the setting of concurrent parvovirus-associated impairment of erythropoiesis.



**Figure 2.** (A) The patient's recently applied tattoo, with black ink containing iron oxide. (B) Image from the patient's bone marrow biopsy showing a giant erythroblast, likely induced by parvovirus B19 infection.