

## Original Article

## A Cross-Sectional Study of Anemia in Human Immunodeficiency Virus-Infected Patients in Iran

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**Background:** Anemia is a frequent complication of infection with human immunodeficiency virus (HIV). The causes of HIV-related anemia are multifactorial. This study was conducted to evaluate the factors associated with anemia in HIV-infected patients.

**Methods:** A total of 642 patients with HIV/AIDS attending the HIV Clinic at Imam Khomeini Hospital in Tehran, Iran enrolled in this study. A detailed history and physical examination was done for all the patients. Investigations included CD4+ count, hemoglobin concentration, and red blood cells morphology.

**Results:** Among HIV-infected patients, 87% were males. The mean duration of antiretroviral therapy was 17.9±9.2 months. The mean (±SD) hemoglobin level was 12.9 ±2.31 mg/dL. Evaluation of red blood cell morphology showed macrocytosis in 11%, normocytosis plus normochromia in 41.1%, and microcytosis plus hypochromia in 47.9% of the patients. The prevalence of anemia (defined as hemoglobin<10 mg/dL) was 10.3%. Anemia was positively associated with female sex (OR=3.01), CD4 level (CD4 count of <200) (OR=3.49), and antituberculous drug administration (OR=4.57).

**Conclusion:** Female sex, stage of HIV infection, and antituberculous drug use were the most important factors associated with anemia in HIV-infected patients in our study.

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**Keywords:** Anemia • hemoglobin • HIV • risk factors

### Introduction

Anemia is a very common finding in patients with human immunodeficiency virus (HIV) infection, particularly in individuals with more advanced HIV disease. In a study of patients receiving no myelosuppressive therapies, 8% of asymptomatic HIV-seropositive patients, 20% of those with symptomatic middle-stage HIV disease, and 71% of those with Center

for Disease Control (CDC)-defined AIDS were anemic.<sup>1</sup>

Several causes of anemia have been described in HIV-positive patients, such as changes in cytokine production with subsequent effects on hematopoiesis,<sup>2-4</sup> decreased erythropoietin concentrations,<sup>5,6</sup> opportunistic infectious agents such as *Mycobacterium avium* complex<sup>7</sup> and parvovirus B-19,<sup>8</sup> administration of chemotherapeutic agents such as zidovudine,<sup>9</sup> ganciclovir,<sup>10</sup> and trimethoprim-sulfamethoxazole (TMP-SMX),<sup>11</sup> and myelophthisis caused by cancers such as malignant lymphoma. Other mechanisms for HIV-associated anemia, although uncommon, include vitamin B12 deficiency<sup>12</sup> and the autoimmune destruction of red blood cells (RBCs).<sup>13</sup> Direct infection of marrow precursor cells has been hypothesized, but not proven.<sup>14</sup> HIV infection alone, without other complicating illnesses, may produce anemia in some patients.<sup>5</sup>

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Anemia has been associated with progression to acquired immunodeficiency syndrome (AIDS),<sup>15</sup> and shorter survival times,<sup>16,17</sup> in HIV-infected patients.

Gastrointestinal bleeding should also be considered in the evaluation of HIV-infected patients with anemia. In addition to the usual causes of gastrointestinal blood loss, HIV-related infections such as cytomegalovirus colitis and malignancies such as Kaposi's sarcoma and non-Hodgkin's lymphoma may produce clinically significant bleeding.<sup>18</sup>

Understanding the association between anemia and survival is important because different choices for treatment of anemia including recombinant human erythropoietin (r-huEPO),<sup>19</sup> correction of nutritional deficiencies, blood transfusion, and in drug-induced anemia, cessation of myelosuppressive therapies,<sup>20</sup> are available nowadays.

This study was conducted to evaluate the factors associated with anemia in HIV-infected patients.

## Materials and Methods

A cross-sectional study was performed on 642 HIV-infected adults attending the HIV Clinic at Imam Khomeini Hospital in Tehran, Iran. Imam Khomeini Hospital is the biggest teaching hospital affiliated to Tehran University of Medical Sciences. Patients from all regions of the country are admitted to this hospital, representing a wide spectrum of HIV presentation in Iran.

A detailed history and physical examination was obtained from all HIV-infected patients using a standard questionnaire accomplished by the attending physician. Clinical and laboratory information included age, sex, medical history, antiretroviral drugs consumption, duration of antiretroviral therapy, antituberculous (anti-TB) and antitoxoplasmosis drugs consumption, route of HIV transmission, type of anemia, and CD4 counts were determined for all of the HIV-infected patients. RBC morphology was assessed by light microscopy, on Giemsa-stained samples. Anemia was defined as a hemoglobin (Hb) <10 mg/dL.

A written informed consent was obtained from each patient. The study protocol was reviewed and approved by Institutional Review Board of Tehran University of Medical Sciences.

Statistical analysis was performed using SPSS version 13 (SPSS Inc., Chicago, IL, USA). Values were tested for statistical significance using Chi-

square test in appropriate situation. A *P* value of 0.05 or less was considered significant. Multiple logistic regression was performed to describe the association of demographic variables (sex, age, and route of HIV exposure), stage of the disease (CD4 T-lymphocyte count <200 cells/ $\mu$ L), and concurrent illnesses and chemotherapeutic agents with the occurrence of anemia. The results were reported as unadjusted and adjusted odds ratios (OR), with 95% confidence intervals (CI).

## Results

The study included a total of 642 patients with HIV/AIDS. Table 1 shows the demographic characteristics of the patients. The mean age of the patients was 36.3 $\pm$ 9.2 years (range: three to 75 years). Of the patients, 87% (557 patients) were males. The mean duration of antiretroviral therapy was 17.9 $\pm$ 9.2 months (range: one to 120 months). The mean Hb was 12.9 mg/dL $\pm$ 2.31 (SD). Injection drug use was the highest transmission route of HIV (52.8%). TMP-SMX, isoniazid (INH) plus vitamin B6, acyclovir, fluconazole, and anti-

**Table 1.** Baseline data of the patients with HIV/AIDS.

Characteristics	Patients with HIV/AIDS No. (%)
Sex	
Male	559 (87%)
Female	83 (13%)
Risk factor	
Injection drug use	337 (52.8%)
Sexual contacts	39 (6%)
Blood transfusion	40 (6.3%)
Maternal-fetal transmission	7 (1.1%)
Others	215 (33.7%)
Underlying disease	637 (99.2%)
Antiretroviral drugs	237 (37.1)
Antituberculous drugs	46 (7.2%)
Antitoxoplasmosis drugs	7 (1.1%)
Opportunistic infections	186 (31.1)
Stage of HIV	
HIV infected	390 (60.9%)
AIDS	250 (39.1%)
Type of anemia	
Macrocytic anemia	32 (11%)
Normocytic normochromic anemia	120 (41.1)
Hypochromic microcytic anemia	140 (47.9%)

HIV=human immunodeficiency virus.

lipid drugs were used by 154 (24.2%), 152 (23.9%), 14 (2.2%), 61 (9.6%), and three (0.5%) patients, respectively.

Frequencies of antiretroviral drugs used by the patients are as follows: 127 (19.9%) zidovudine (AZT)+lamivudine (3TC)+nelfinavir (NFV), 30 (4.7%) patients AZT+3TC+efavirenz (EFV), 25 (3.9%) patients AZT+3TC+nevirapine (NVP), 24 (3.7%) patients stavudine (d4T)+3TC+NFV, nine (1.4%) patients d4T+3TC+EFV, 16 (2.5%) patients d4T+3TC+NVP, and six (0.9%) patients other drugs.

RBC morphology showed macrocytosis in 11%, normocytosis plus normochromia in 41.1%, and microcytosis plus hypochromia in 47.9% of the patients.

Table 2 indicates the factors associated with anemia in HIV-infected patients. There was no association between the type of anemia and underlying disease ( $P>0.271$ ), and prescription of acyclovir ( $P=0.117$ ) and fluconazole ( $P=0.368$ ). Also, no relationship between the type of anemia and the antiretroviral regimens including AZT+3TC+NVP ( $P=0.433$ ), d4T+3TC+EFV ( $P=0.166$ ), and d4T+3TC+NVP ( $P=0.316$ ) was detected. Anemia was positively associated with drug history, use of TMP-SMX, anti-TB drugs, antilipid drugs, antiretroviral regimens [AZT+3TC+NFV ( $P=0.005$ ), AZT+3TC+EFV ( $P=0.007$ ), d4T+3TC+NFV ( $P<0.0001$ )], and also

opportunistic infections ( $P=0.001$ ) and stage of HIV infection ( $P<0.001$ ).

Anemia was positively associated with female sex, clinical AIDS (a CD4 count of  $<200$ ), and administration of anti-TB drugs. It was negatively associated with heterosexual route of transmission and INH plus pyridoxine administration (Table 3).

## Discussion

A variety of hematologic abnormalities associated with HIV infection has been described in different studies. Although primarily characterized by a specific deficit in CD4 T-lymphocytes, depletion of other cell lines including neutrophils, thrombocytes, and RBCs have been observed in HIV-infected individuals.<sup>21-24</sup> While some investigators have suggested that anemia occurs particularly in the later stages of HIV infection,<sup>23</sup> others have reported it as an early sign of HIV infection.<sup>25,26</sup>

Multifactorial origin of anemia complicates determining its original cause and/or its proper treatment.<sup>27</sup>

Diallo et al. showed that anemia was more frequent in women than in men ( $P=0.00003$ ).<sup>28</sup> We also found a borderline relationship between female sex and anemia ( $P=0.05$ ). According to Fangman and Scadden's study, women, blacks, injection drug users, and people with advanced

**Table 2.** Factors associated with anemia in HIV-infected patients.

Factors	Type of anemia			P value
	Macrocytosis	Normocytosis plus normochromia	Microcytosis plus hypochromia	
Sex				0.618
Male	28	105	116	
Female	32	120	139	
Exposure route				0.608
Underlying disease				0.271
Drug history	24	65	55	$<0.001$
TMP-SMX	13	36	25	0.006
INH+vitamin B6	11	20	24	0.050
Antituberculous drugs	7	11	8	0.013
Antiretroviral drugs	28	50	31	$0<0.001$
Acyclovir	2	4	1	0.117
Fluconazole	3	19	15	0.368
Opportunistic infections	17	37	37	0.001
Stage of HIV				$<0.001$
HIV infected	3	63	107	
AIDS	29	57	33	

TMP-SMX= trimethoprim-sulfamethoxazole; INH= isoniazid.

**Table 3.** Logistic regression models showing the associations of incident anemia in HIV-infected patients.

Variable	Presence of anemia (Hb<10 mg/dL) (n=642)	
	Unadjusted OR (CI 95%)	Adjusted OR (CI 95%)
Gender, Female	0.935 (0.429–2.038)	4.156 (1.291–13.378)
Age≥45 years old	1.075 (0.565–2.047)	0.925 (0.424–2.020)
HIV exposure route		
Maternal-fetal transmission	Referent	Referent
Injecting drug use	2.111 (1.019–4.374)	6.632 (0.930–47.277)
Heterosexual sex	0.443 (0.236–0.832)	0.366 (0.145–0.923)
Hemophilia/transfusion recipient	1.239 (0.468–3.281)	3.748 (0.322–43.590)
Other	0.852 (0.107–6.765)	4.426 (0.240–81.705)
Stage of disease	1.414 (0.847–2.360)	1.357 (0.298–6.176)
CD4 count < 200 cells/μL	3.078 (1.803–5.257)	2.396 (0.946–6.067)
Concurrent illness		
HCV infection	0.985 (0.573–1.695)	0.917 (0.461–1.822)
HBV infection	1.475 (0.496–4.393)	1.268 (0.357–4.504)
Hemophilia	0.821 (0.188–3.583)	0.674 (0.050–9.044)
Opportunistic infections	1.685 (0.984–2.885)	0.879 (0.377–2.047)
Chemotherapeutic agents		
Zidovudine	1.693 (0.898–3.191)	4.358 (1.401–13.552)
Lamivudine	0.911 (0.537–1.545)	3.464 (0.290–41.347)
Nelfinavir	0.620 (0.356–1.081)	0.170 (0.018–1.602)
Efavirenz	2.207 (0.520–9.379)	0.454 (0.033–6.312)
Nevirapine	2.336 (0.551–9.905)	—
Stavudine	0.310 (0.152–0.629)	—
Acyclovir	0.661 (0.085–5.137)	0.785 (0.077–7.961)
Fluconazole	1.351 (0.612–2.982)	0.929 (0.306–2.826)
Trimethoprim-sulfamethoxazole	1.687 (0.974–2.923)	1.445 (0.572–3.648)
Antituberculous drugs	4.015 (1.990–8.103)	4.326 (1.788–10.470)
Isoniazid plus vitamin B6	0.476 (0.230–0.988)	0.351 (0.146–0.842)

HCV=hepatitis C virus; HBV=hepatitis B virus.

disease suffer more from anemia and should be screened.<sup>29</sup> In our study, anemia was more frequent in patients with advanced disease (AIDS) rather than in HIV infection itself. Dancheck et al. suggested that injection drug use was an independent risk factor for iron-deficiency anemia among HIV-seropositive women.<sup>30</sup> We also found such risk factors for anemia among HIV-seropositive patients (OR=3.645).

In our study, 315 out of the 642 patients had abnormal RBC morphology, in which microcytosis plus hypochromia was the most frequent finding, while in Eley et al.'s study, anisocytosis was the most frequent observation.<sup>31</sup> It was usually correlated with an increased RBC distribution width in many children.<sup>32</sup>

Administration of TMP-SMX can cause drug-associated aplastic anemia or immune-mediated destruction of specific populations of blood cells.<sup>11</sup> We could not find any association between the administration of TMP-SMX and anemia in the studied patients ( $P=0.253$ ).

In general, the likelihood of anemia increases with progressive immunologic deterioration and with the advancement of HIV-related disease.<sup>24</sup> A CD4+ T-lymphocyte count less than 200 cells/μL is independently associated with the development of anemia. Our data also showed such a relationship, and the patients with AIDS were more likely to develop anemia compared with HIV-infected patients.

It is claimed that both AZT and d4T induce a metabolic defect in developing RBC precursor.<sup>33</sup> However, AZT, but not d4T, has broader myelosuppressive effects both *in vitro* and *in vivo*. Its mechanism of induction of anemia possibly relates to the reduction of globin mRNA synthesis.<sup>34</sup> According to Moyle et al.'s study, AZT-based highly active antiretroviral therapy (HAART) had a greater negative impact on hematologic parameters compared with the d4T-based regimens. The AZT recipients are more likely to experience anemia and neutropenia events of any grade than the d4T recipients.<sup>35</sup> Our data

indicated that anemia was influenced by antiretroviral regimens of AZT+3TC with NFV, AZT+3TC with EFV, and d4T+3TC+NVF. However, Moore and Forney, and Semba et al.'s studies are in contrast to these results.<sup>36,37</sup> They found that HAART was an effective treatment of anemia of HIV infection and the potential mechanisms that might be involved included a reduction in opportunistic infections and the anemia of chronic disease, and an improvement in nutritional status.

The main limitation of our study was that the data which allow the classification of the causes of anemia such as reticulocyte counts, erythropoietin levels, and parvovirus IgM titers were not measured.

Anemia in HIV-infected patients, if persistent, is associated with substantially decreased survival. Consideration should be given to evaluate the effects of treating anemia in a prospective study design. If recovery from anemia is shown to directly increase survival, screening for anemia should be aggressive and the patients with anemia should be treated.

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