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Haematological characteristics and HIV status of pregnant women in Abidjan, Côte d'Ivoire, 1995–96

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Abstract

To describe the haematological profile of pregnant women and to compare these characteristics according to HIV serostatus in Abidjan, Côte d'Ivoire, a cross-sectional study was made in the context of a research intervention programme to reduce mother-to-child transmission (MTCT) of HIV (ANRS 049 trial). HIV testing was systematically proposed to pregnant women attending the mother and child health clinic of a community health centre. Blood samples were tested for HIV antibodies using Genelavia™ and Peptilav™. The haematological parameters were measured with a Coulter counter. From May 1995 to March 1996, 1646 pregnant women accepted HIV testing and had a full blood count available. The prevalence of HIV infection was 12·0% ($n = 197$). The prevalence of anaemia (haemoglobin [Hb] <11 g/dL) was 70·1%, $n = 1155$ (95% confidence interval 68–72%) and significantly higher in HIV+ (81·7%, $n = 161$) than in HIV− women (68·9%, $n = 994$) ($P < 0.001$). Severe anaemia (Hb < 7 g/dL) was present in 1·9% of the women ($n = 31$), 4·6% ($n = 9$) in HIV+ and 1·5% ($n = 22$) in HIV− women ($P < 0.001$). HIV infection, primigravidae and secundigravidae were factors independently associated with anaemia. Anaemia was highly prevalent in this population while severe anaemia was rare. HIV infection was a contributor to anaemia in pregnancy. As zidovudine, with its known haematological toxicity, has recently been introduced to prevent MTCT of HIV in developing countries, screening HIV+ women for severe anaemia is necessary.

Keywords: HIV, women, anaemia, pregnancy, Africa

Introduction

Anaemia is the most common haematological consequence of pregnancy. The physiological anaemia of pregnancy is a dilutional process secondary to an increase in plasma volume. Beside this physiological process, nutritional deficiencies, haemolysis and chronic diseases can cause anaemia that may affect the mother and the foetus; iron deficiency is the major cause of anaemia in this context together with folate deficiency, haemoglobinopathies and parasitic infections such as malaria (SCRIMSHAW, 1991; VITERI, 1994). These causes of anaemia are generally associated with poor socioeconomic, health and nutritional conditions and are especially prevalent in the tropics (FLEMING, 1989).

Anaemia during pregnancy is associated with increased risk of maternal and foetal morbidity (premature delivery, low birthweight) and mortality (JACKSON & LATHAN, 1982; FLEMING, 1989; WILLIAMS & WHEBY, 1992; VITERI, 1994).

The human immunodeficiency virus (HIV) has also emerged as a general cause of anaemia, especially in sub-Saharan Africa (FLEMING, 1989; HOXIE, 1991) and has negative effects on pregnancy outcome (BRADDICK *et al.*, 1990) adding a new risk to the mothers and their infants, regardless of mother-to-child transmission of HIV. Little information is available on HIV-related anaemia in adults in Africa (MAKUWA *et al.*, 1990; BEUZER *et al.*, 1992; ZUCKER *et al.*, 1994; SHULMAN *et al.*, 1996).

Pregnant women are a vulnerable group badly affected by the spread of the HIV epidemic in Africa. In Abidjan, the largest city of Côte d'Ivoire, the prevalence of HIV has been estimated at 13–15% in women attending antenatal clinics (SYLLA-KOKO *et al.*, 1997). Moreover, AIDS is the second leading cause of mortality among young women after complications of pregnancy (DE COCK *et al.*, 1990).

The purpose of this study was to describe the haematological profile of pregnant women in a low-income population with a high prevalence of HIV infection in Abidjan, Côte d'Ivoire, and to compare these characteristics according to HIV serostatus. The research has been conducted in the context of a clinical trial.

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Methods

Background

Since February 1995, a research intervention programme to reduce mother-to-child transmission of HIV (Projet DITRAME, ANRS 049 trial) has been started in the Formation Sanitaire Urbaine of Yopougon, a community health centre located in one of the urban districts of Abidjan.

The first step of this programme was to implement voluntary HIV testing among pregnant women. In this context, another objective was to estimate the prevalence of anaemia in a population proposed for a therapeutic trial with a simplified regimen of zidovudine (AZT), in order to study its acceptability, tolerance and efficacy in an African context (DABIS *et al.*, 1999).

Selection of the sample

Information about maternal age, gestational age and expected place of delivery was collected from all pregnant women coming for their first prenatal visit to the maternal and child health clinic of the Yopougon health centre. HIV testing was then systematically proposed, after an individual pre-test counselling, to those who fulfilled the following criteria: aged ⩾18 years, planning to deliver in Abidjan, and pregnancy < 32 weeks. A blood sample was obtained for HIV testing, syphilis serology and full blood cell count after a written informed consent. Pregnant women returning for the post-test counselling and the blood test results were given treatment or prophylaxis for anaemia and syphilis when needed. HIV-infected (HIV+) women were then proposed for entry in the ANRS 049 trial mentioned above.

Biological methods

All serum samples were screened by a commercial enzyme immunoassay (Genelavia™; Pasteur, Paris, France) for HIV antibodies. When positive, a commercial immunoenzymatic strip method using 2 synthetic peptides (Peptilav™; Sanofi Diagnostics Pasteur, Paris, France) was used to confirm the result and discriminate

HIV types 1 and 2. This algorithm had already been validated in Côte d'Ivoire (DE COCK *et al.*, 1991).

Haemoglobin (Hb) concentration, packed cell volume (PCV), erythrocytes, white blood cells, platelet counts and red cell indices, including mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC), were assayed using an electronic counter (T 890 Coulter™). Blood sample for this purpose had been taken using EDTA-anticoagulated tubes. Peripheral blood smears stained with May Grunwald Giemsa were examined under oil immersion for white blood cell differential count.

Statistical analysis

EpiInfo 5™ software was used for univariate analysis; χ^2 test, Fisher's exact test and Kruskal–Wallis test were used for comparisons with a significance level of 0·05. Multivariate analysis was performed with Egret™ statistical software (Statistical Epidemiological Research Corporation, Seattle, Washington, USA). Variables found in the univariate analysis to have a P value $< 0{\cdot}15$ were included in the multivariate model looking for determinants of anaemia.

Results

From May 1995 to March 1996, HIV testing was proposed to 3147 eligible women attending the clinic for their first prenatal visit: 1646 pregnant women accepted and were screened for HIV infection and had a full blood count at the same time. Overall, their mean age was 25 years (standard deviation [SD] 5·7 years, range 18–45 years). The mean gestational age was 28 weeks (SD 2·6 weeks, range 18–37 weeks). The average number of pregnancies, including the current one, was 3·5 (SD 2·2, range 1–13). Seventeen percent of women were primigravidae, 10% gravida 2, 51% gravida 3–5 and 21% gravida ≥ 6. Women having a stable relationship comprised 83% of the total. Illiterate women represented 41% of the sample; 34% had achieved primary school and only 24% had reached secondary high school or above. Women were housewives in 49% of the cases and informal traders in 39%.

In this population, the prevalence of HIV infection was 12·0%, $n = 197$ (95% confidence interval [CI] 10·4–13·6%). Seroprevalence was 10% for HIV-1, 1·4% for HIV-2 and 0·6% for dually reactive sera. HIV+ women were comparable to HIV-negative (HIV−) women in terms of age, educational level and marital status.

Table 1 shows the blood count characteristics according to HIV serostatus. There was a significant lower mean Hb concentration and PCV in HIV+ compared to HIV− women. We had the whole white blood cell differential count available for 181 HIV+ and 1344 HIV− women, 92% of the sample. The average number of white blood cells, neutrophils and lymphocytes was lower for HIV+ than for HIV− women. Other haematological characteristics were comparable between the 2 groups.

The prevalence of anaemia, as defined by the World Health Organization (WHO) by Hb < 11 g/dL, was 70·1% (95% CI 68–72%) in this population. The overall frequency of anaemia was significantly higher in HIV+ ($n = 161$, 81·7%) than in HIV− women ($n = 994$, 68·9%), $P < 0{\cdot}001$. HIV infection, primigravidae, secundigravidae, young age and living alone were significantly associated with anaemia in univariate analysis (Table 2). In the logistic regression analysis looking for determinants of anaemia, HIV infection, primigravidae and secundigravidae remained independently associated with anaemia. Thus, the risk of anaemia was twice higher in HIV+ than in HIV− women ($P < 0{\cdot}001$) (Table 2).

The distribution of anaemia according to the red cell indices was: hypochromic (MCH < 27 pg) in 27·1% of the cases, normochromic ($27 \leq$ MCH < 33 pg) in 70·2% and macrocytic (MCV > 95 fl) in 2·7%.

Pregnant women presented severe anaemia (Hb < 7 g/dL according to WHO guidelines) in 1·9% of cases, moderate anaemia ($7 \leq$ Hb < 10 g/dL) in 44·3% and mild anaemia ($10 \leq$ Hb < 11 g/dL) in 24·2%. HIV+ women presented more frequently moderate (53·8% vs 42·9%) or severe anaemia (4·6% vs 1·5%) than HIV− women and this difference was statistically significant ($P < 0{\cdot}001$). There was no difference in the characteristics of anaemia according to the erythrocytic indices in relation to HIV infection.

Discussion

Anaemia was highly prevalent among pregnant women in this urban population of West Africa whereas severe anaemia was rare. This sample showed the same socio-demographic characteristics as women refusing to be tested for HIV infection and to participate in the study, this being a fact in favour of its good representativity in a population with high attendance at antenatal care services. Published figures in other parts of Africa have shown a great variability in the prevalence of anaemia. Our findings are nevertheless in the range of previously reported figures. In 1982 in Liberia, West Africa, the prevalence of anaemia was 78% in women in their third trimester of gestation (JACKSON & LATHAN, 1982); in western Kenya it was 55% in 1994 (ZUCKER *et*

Table 1. Characteristics of full blood count in HIV-infected (HIV+) and uninfected (HIV−) pregnant women, Abidjan, Côte d'Ivoire, 1995–96 (DITRAME ANRS 049)

Parameter	HIV+ women ($n = 197$)	HIV− women ($n = 1441$)	P[a]
Haemoglobin (g/dL)	9·64 ± 1·5	10·2 ± 1·4	<0·00001
Packed cell volume (%)	29·3 ± 4·4	31·1 ± 3·9	<0·00001
Erythrocytic indices			
Mean corpuscular volume (fl)	86·6 ± 7·2	87·2 ± 7·9	0·12
Mean corpuscular haemoglobin (pg)	28·4 ± 2·9	28·6 ± 3·2	0·16
Mean corpuscular haemoglobin concentration (g/dL)	32·7 ± 1·3	32·8 ± 1·1	0·43
White blood cells (/mm³)	5936 ± 1977[b]	6721 ± 1929[c]	<0·00001
Neutrophils (/mm³)	3642 ± 1417[b]	4252 ± 1528[c]	<0·0001
Eosinophils (/mm³)	238 ± 299[b]	223 ± 265[c]	0·48
Lymphocytes (/mm³)	1945 ± 776[b]	2086 ± 675[c]	0·01
Platelets (/mm³)	224 000 ± 105 500	213 358 ± 68 720	0·06

Values are mean ± standard deviation.
[a]Kruskal–Wallis test.
[b]$n = 181$.
[c]$n = 1344$.

Table 2. Univariate analysis of factors associated with anaemia in a population of 1646 pregnant women, Abidjan, Côte d'Ivoire, 1995–96 (DITRAME ANRS 049)

	n	Anaemia No. (%)[a]	*P* value (univariate)	Odds ratio[b] (CI)
All women	1646	1155 (70·1)		
HIV infection serostatus				
HIV+	197	161 (81·7)	<0·001	2·05 (1·40–3·00)
HIV−	1442	994 (68·9)		
Parity				
Primigravidae	285	219 (76·8)	<0·001	1·62 (1·14–2·31)
Gravida 2	170	137 (80·6)		1·94 (1·25–3·02)
Gravida 3–5	840	568 (67·6)		0·99 (0·76–1·29)
Gravida ⩾ 6	350	234 (66·9)		Reference
Abortion history				
Yes	520	362 (69·6)	0·61	
No	1126	797 (70·8)		
History of stillbirth				
Yes	100	65 (65·0)	0·19	
No	1546	1094 (70·8)		
History of infant death				
Yes	206	146 (70·9)	0·23	
No	1440	1013 (70·3)		
Maternal age (years)				
<25	905	669 (73·9)	0·002	1·12 (0·67–1·87)
25–34	631	416 (65·9)		0·94 (0·59–1·48)
⩾35	110	74 (67·3)		Reference
Marital status				
Living alone	278	214 (77·0)	0·01	0·85 (0·62–1·87)
Living in couple	1362	943 (69·2)		
Instruction level				
Illiterate	680	484 (71·2)	0·18	
Primary school	555	400 (72·1)		
Secondary school or above	400	268 (67·0)		

[a]Haemoglobin <11 g/dL.
[b]Multivariate analysis.
CI, 95% confidence interval.

al., 1994); in Zanzibar, Tanzania, it was 69·7% in 1994 (MATTEELLI *et al.*, 1994); and in north Mombasa, Kenya, it was 75·6% in 1996 (SHULMAN *et al.*, 1996). Severe anaemia was less prevalent in Abidjan than in the latter countries (1·9% versus 6·0%, 9·3% and 9·8% respectively).

The prevalence of HIV infection was 12·0% of the overall sample, this figure being consistent with another seroprevalence study conducted in the same city (SYLLA-KOKO *et al.*, 1997). The majority of these women were infected by HIV-1, the predominant virus type in this part of Africa and the most implicated in mother-to-child transmission (ADJORLOLO *et al.*, 1994; DABIS *et al.*, 1999).

In our study, HIV infection was a contributor to anaemia in pregnancy, as has already been described (VAN DEN BROEK *et al.*, 1998). The relationship between HIV infection and severe anaemia has also been described (ZUCKER *et al.*, 1994). We also found this association although severe anaemia was rare.

In HIV infection the depletion of other cell lines including neutrophils and thrombocytes has also been described (PERKOCHA & RODGERS, 1988; HOXIE, 1991). We did not observe leucopenia, lymphopenia or thrombocytopenia in the overall sample, and no relation with HIV infection, although white blood cell, lymphocyte and neutrophil mean counts were significantly lower in HIV+ women.

To further characterize the type of anaemia, we have chosen the MCV to show changes in red cell size and the MCH to show chromic changes (CAU & TCHERNIA, 1984). In 63% of the cases, anaemia was normocytic normochromic, probably indicating the dilutional process of pregnancy, and there was no difference according to the HIV serostatus, which is also coherent with the type of anaemia predominantly observed in HIV infection (PERKOCHA & RODGERS, 1988).

We did not take into account malaria infection as a possible confounder in the role of HIV infection in anaemia in our study. Some studies have not shown an association between HIV infection and malaria parasitaemia (NGUYEN-DINH *et al.*, 1987; MULLER & MOSER, 1990) whereas this association has been found in Malawi (BLOLAND *et al.*, 1995; STEKETEE *et al.*, 1996). We observed that primigravidae and secundigravidae were independent risk factors of anaemia. In countries where malaria is endemic, malaria parasitaemia has been found to be more frequent in primigravidae and could be the cause of anaemia (MATTEELLI *et al.*, 1994; SHULMAN *et al.*, 1996), but it has not been described to be more frequent in secundigravidae. In our study women attending a prenatal clinic for their first or second pregnancy were younger and more frequently living alone and probably had less financial support, facts that could have negative consequences on the amount of resources devoted to food purchase.

In summary, our study allowed us to characterize the haematological profile of urban pregnant women. Anaemia in pregnancy is highly prevalent in most African settings where women are attending clinics late in their pregnancy. The aetiology of anaemia is multifactorial and its prevention in these countries should be addressed

to correct all its contributing factors, including measures such as malaria treatment and chemoprophylaxis, iron and folic supplements, HIV-prevention programmes, improvement of maternal and child access to care, and education of women to attend antenatal care services as early as possible in pregnancy.

Finally, although severe anaemia is a contraindication for anti-retroviral therapy, the relatively low prevalence of severe anaemia in this population should not create impediments to implement perinatal transmission control programmes using a short course of zidovudine, which efficacy has been proven in Thailand (VUTHIPONGSA *et al.*, 1998) and in Côte d'Ivoire (DABIS *et al.*, 1999; WIKTOR *et al.*, 1999).

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