

AUTOCHTONOUS FALCIPARUM MALARIA IN BELGIUM

by

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Summary — Severe *Plasmodium falciparum* infection was observed in two brothers living close to the Brussels international airport. In spite of delayed diagnosis both made an uneventful recovery with oral chloroquine therapy. After exclusion of other mechanisms of transmission it is concluded that they were infected by an anopheles escaped from an aircraft. The problem of autochthonous malaria in Western Europe is discussed and a list is given of 19 cases of airport-malaria observed since 1969.

KEYWORDS : Malaria; *Plasmodium falciparum*; Belgium; Imported Diseases.

Indigenous malaria has disappeared from Belgium in 1938 (Rodhain & Van Mechelen, 1944). Since that time the increase of international travel and the influx of migrant labour have resulted in an upsurge of imported malaria (Eyckmans, 1981). We report here on the observation of severe infection with *Plasmodium falciparum* occurring simultaneously in two brothers who had never been outside their homeland.

Case 1. (M... Guy)

An 18-year-old mechanic was in perfect health until July 29, 1982, when headache, chills, nausea and high fever to 40 °C developed. Treatment was started with doxycycline and after two days replaced by amoxicillin, both without success. A subconjunctival effusion and bleeding of the nose were observed. Blood examined on August 4th showed: haemoglobin 15 g/dl, white cells $5.4 \times 10^9/l$, platelets $140 \times 10^9/l$, conjugated bilirubin 1.24 mg/dl, creatinine 1.6 mg/dl, urea (nitrogen) 73 mg/dl. From August 6th to August 15th the patient felt better but when the fever and the chills recurred he was referred to our hospital. Physical examination did only reveal splenomegaly. There was a progressive decline in haemoglobin to 6.9 g/dl with evidence of haemolysis: raised reticulocyte count (8 per cent), lactic dehydrogenase (LDH) increased to 817 U/l. Platelet count fell to $85 \times 10^9/l$; the leucocyte count remained normal with a maximum of 33 per cent mononuclear cells. The blood urea (nitrogen) was 36 mg/dl, the creatinine 0.9 mg/dl, the uric acid 6.1 mg/dl. The serum aspartate aminotransferase (SGOT) was 16 U/l, the bilirubin 0.53 mg/dl. Cultures of urine and blood were negative as were antibodies against viruses, toxoplasma and leptospira.

Fever recurred daily with peaks of 40 °C. On August 25th a Giemsa-stained thick blood smear disclosed numerous young trophozoites and

typical crescentic gametocytes of *P. falciparum*. The patient was treated with oral chloroquine, 2 g (base) over 5 days. The fever did not recur, but rare gametocytes were seen in the thick drop up to one week after the end of chemotherapy. The indirect immunofluorescence antibody test for malaria was negative on August 26, positive at 1/20 with falciparum antigen on September 3, and again negative on September 23.

Case 2. (M... Dirk)

His 24-year-old brother, also a mechanic, living and working in the same house, was admitted on August 11th, 1982, because of convulsions and delirium, after 6 days of illness with headache, chills and high fever (40 °C), not influenced by three days' treatment with doxycycline.

On admission he was comatose with Cheyne-Stokes respiration. The temperature was 38.5 °C, the pulse rate 128, the blood pressure 120/60 mm Hg. Jaundice was observed with hepatosplenomegaly and a subconjunctival effusion in the left eye. The haemoglobin was 10.9 g/l, white-cell count $21.7 \times 10^9/l$ with differential count: 86 per cent segmented neutrophils, 4 per cent lymphocytes and 10 per cent monocytes. The platelet count was $40 \times 10^9/l$, the prothrombin time 100 per cent. The serum creatinine was 9.55 mg/dl, the urea (nitrogen) 314.5 mg/dl, the uric acid 24.5 mg/dl, sodium 123 mmol/l, potassium 4.75 mmol/l, chloride 85 mmol/l, carbon dioxide 14.3 mmol/l, calcium 7.4 mg/dl, and phosphorus 4.5 mg/dl. Bilirubin was 8 mg/dl, SGOT 139 U/l, LDH 737 U/l, gamma glutamyltransferase 37 U/l, alkaline phosphatase 134 U/l. Haptoglobin was decreased. A chest X-ray was normal. Blood and urine cultures remained sterile. Cerebrospinal fluid was xanthochromic with 193 leucocytes per μl , almost all neutrophils, glucose 79 mg/dl and protein 81 mg/dl. Direct Gram stain and culture were negative. The patient was put on haemodialysis and with supportive therapy the fever subsided after one day, jaundice disappeared and renal function improved. He became alert a week later.

Ten days after his admission, anaemia recurred (Hb 8.7 g/dl) with increasing reticulocytosis, high LDH and lowered haptoglobin. However, the patient felt better and remained afebrile.

On August 26th, so soon as malaria had been diagnosed in his brother, a thick blood smear was examined and numerous gametocytes of *P. falciparum* were found. After having been given the same treatment as his brother the anaemia resolved, the gametocytes gradually disappeared over one week and the patient remained well.

Fluorescent antibodies against *P. falciparum* were absent on August 26th, they were weakly (1/20) positive on September 3, and had completely disappeared on September 23.

Since both patients had never traveled outside Belgium and had neither history of blood transfusion or of drug abuse, the question rose how they could have been infected. The brothers live with their parents at Perk, a rural village situated at less than 2 km from the cargo section of the Brussels International Airport. They do not work at the airport and never visited the airport together. It is probable therefore that they were bitten by the same infected anopheles, brought in by an aircraft from a tropical country, presumably from Central Africa. The incubation time of *P. falciparum*

parum infection rarely exceeds 9-12 days. If we take into account the direction of the wind (there should have been a south to south-west-wind to allow a mosquito to be drifted from the airport to the patients home), they must have been infected on the 14th to 16th of July. The temperature then was exceptionally high with a night minimum of 14.6 °C and a maximum of 29.7 °C.

Discussion

Autochthonous or indigenous malaria comprises all cases of malaria infection acquired by an anopheles-bite in the country itself. The anopheles might be either autochthonous or imported. This definition excludes imported malaria, malaria transmitted by transfusion of blood or blood products, accidental transfer by an infected needle prick as may happen in intravenous drug users and occasionally in hospital personnel (Borsch *et al.*, 1982), and also congenital malaria. According to Gentilini and Danis (1981), three different patterns of autochthonous malaria can be observed in Western Europe.

1. Introduced malaria

Introduced malaria is an infection with Plasmodium transmitted by a local anopheles in a country which achieved eradication. Introduced malaria, by definition, is secondary to imported malaria. A typical example is Corsica, where malaria had been eradicated in the sixties. In 1970-71 30 patients, tourists and Corsicans, with *P. vivax* infection were notified in Corsica (Ambroise-Thomas, Quilici & Ranque, 1972). In the same period there was an important immigration of North Africans in Corsica, some of them possibly carrying gametocytes of *P. vivax*. The fact that the anti-mosquito measures had been less stringent than before, added to a period of favourable weather, may have contributed to this outbreak. Other examples of introduced malaria are the 200 infections in the French Camargue in 1943 (Sautet, 1944) due to a Vietnamese strain of *P. vivax*. A similar focus in 1974 in California was caused by a *P. vivax* imported from India (Singal *et al.*, 1977).

Introduced malaria is only possible when some conditions are fulfilled (Rodhain & Charmot, 1982) :

- a sufficient density of local anopheles;
- a sufficient incidence of imported malaria acting as reservoir of gametocytes;
- sufficient compatibility between the local anopheles and the imported plasmodium-strain;
- optimal climatic factors allowing a complete sporogonous cyclus in the intermediate host.

P. vivax with its rather low temperature requirements (≥ 17 °C), fits best the two latter conditions. No wonder therefore that *P. vivax* was the only known cause of indigenous « polder » fever in the beginning of this century in Belgium (Eyckmans, 1981). In the Dutch isle of Walcheren however 18 infections with *P. malariae* were notified during the period

between 1902 and 1936, among hundreds of cases of *P. vivax* malaria (Limbos *et al.*, 1980). For several reasons, introduction of malaria in Belgium is very unlikely: the reservoir of imported gametocytes of *P. vivax* is rather unimportant, as 63 per cent of all cases of imported malaria are caused by *P. falciparum* (Limbos *et al.*, 1980). Even more important is the scarcity of local anophelism due to extensive urbanisation and to the pollution of surface water with detergents and industrial waste. Indigenous anopheles species *A. atroparvus*, *A. plumbeus* and *A. claviger* (Eyckmans, 1981) are potential vectors of *P. vivax*.

2. Sporadic unexplained cases

Five recent cases of unexplained malaria are reported in the French literature (Cassaigne *et al.*, 1980; Chavanne *et al.*, 1979; Guillausseau *et al.*, 1980; Morin *et al.*, 1980; Saliou *et al.*, 1978), three being caused by *P. falciparum* and two by *P. vivax*. These patients had no history of blood transfusion, drug use, travel in tropical countries or vicinity of an airport. For sporadic infections with *P. vivax* a theoretical explanation exists: an imported gametocyte of *P. vivax* could have been picked up by a local anopheles and transmitted, after completing its sporogony, during a period of favourable weather.

More difficult to explain are the sporadic French cases of *P. falciparum* infection. It has been shown experimentally that West European anopheles are refractory to *P. falciparum* of African or Asiatic origin (Gentilini & Danis, 1981; Rodhain & Charmot, 1982). An anopheles species of temperate countries can only act as a vector of strains of *P. falciparum* from temperate areas. This is exemplified by the occurrence of 19 sporadic cases of *P. falciparum* in France during and in the first years after World War II (Coutelen, Biguet & Doby, 1953). They are supposed to have been derived from soldiers originating from Central and Southern Europe, where *P. falciparum* was still endemic at that time. As malaria is now completely eradicated from Mediterranean Europe, local anopheles should no longer be suspected of transmitting imported *P. falciparum*.

3. Airport malaria

Including our own patients, 19 cases of this type of malaria have been documented since August 1969 (table 1). Five of them occurred in people working at an international airport, all others living or having stayed in the vicinity of an airport. *P. falciparum* was involved in 17 cases. Most cases (15/19) occurred in August with only one during the winter. Having carefully excluded other mechanisms of transmission the only remaining explanation is that an infected anopheles, brought in by aircraft from a tropical country, has managed to bite an individual within an area close to the airport. The possibility of such an event was demonstrated during a flight from Rio de Janeiro to Paris in a Boeing 747, transporting mosquitoes under different circumstances. All survived for more than 4 days (Leger *et al.*, 1981), the limiting factor being the temperature in the aircraft. Since the passenger cabin as well as the luggage-holds are climatized, both offer ideal conditions for the rapid transport of infected anopheles.

TABLE 1
Cases of airport malaria reported in the literature

Time	Species	Circumstances	References
August 1969	<i>P. falciparum</i>	Lives next to the airport of Le Bourget (Fr)	Doby & Guigen, 1981
August 1969	<i>P. falciparum</i>	Idem	Idem
August 1976	<i>P. falciparum</i>	Luggage-worker in the airport of Roissy-Charles de Gaulle (Fr)	Giacomini et al., 1977
August 1976	<i>P. falciparum</i>	Loader of merchandise in the airport of Roissy-Charles de Gaulle (Fr)	Bentata-Pessayre et al., 1978
July 1976	<i>P. falciparum</i>	Hall-porter in a school next to the airport of Roissy-Charles de Gaulle (Fr)	Chauvagnat et al., 1979
August 1977	<i>P. falciparum</i>	Customs-officer at the airport of Roissy-Charles de Gaulle (Fr)	Coloignier et al., 1978
August 1977	<i>P. vivax</i>	Police-man at the airport of Roissy-Charles de Gaulle (Fr)	Larcan et al., 1978
August 1977	<i>P. falciparum</i>	Lives close to the airport of Roissy-Charles de Gaulle (Fr)	Giacomini et al., 1977
February 1978	<i>P. falciparum</i>	Musician in the band of the airport of Roissy-Charles de Gaulle (Fr)	Saliou et al., 1978
June 1978	<i>P. falciparum</i>	Accountant, lives at 5 km of the airport of Le Bourget and of Roissy-Charles de Gaulle (Fr)	Cassaigne et al., 1980
October 1974	<i>P. falciparum</i>	Stayed in a village between the runways of Orly (Fr)	Gentilini et al., 1978
August 1978	<i>P. falciparum</i>	Lives at less than 1.5 km from Schiphol (Amsterdam).	Delennarre & van der Kaay, 1979
August 1979	<i>P. falciparum</i>	Passed a night on a lake at less than 1.5 km from Schiphol	Delennarre-Van de Waal & De Waal, 1981
August 1970	<i>P. falciparum</i>	Soldier on duty next to the airport of Zürich	O. M. S., 1978
August 1970	<i>P. falciparum</i>	Idem	Idem
August 1972	<i>P. malariae</i>	Lives next to the airport of Zürich	Idem
August 1972	<i>P. falciparum</i>	Stayed next to the airport of Zürich	Idem
August 1972	<i>P. falciparum</i>	Lives in the vicinity of Zaventem airport (Brussels)	Holvoet et al., 1983
August 1982	<i>P. falciparum</i>	Idem	Idem

Autochtone falciparum malaria in België.

Samenvatting — Een ernstige malaria-infectie verwekt door *Plasmodium falciparum*, werd vastgesteld bij twee broers die dicht bij de Brusselse internationale luchthaven woonden. In weerwil van de laattijdige diagnose, volgde een vlotte genezing na orale chloroquine behandeling. Na uitsluiting van andere mogelijke mechanismen van overzetting besluiten de auteurs dat de besmetting werd opgedaan door de beet van een anopheles die ontsnapte uit een vliegtuig. Het probleem van de autochtone malaria in West Europa wordt besproken en een lijst opgemaakt van 19 gevallen van luchthavenmalaria opgetekend sinds 1969.

Paludisme autochtone à falciparum en Belgique.

Résumé — Une infection sévère à *Plasmodium falciparum* a été observée chez deux frères habitant à proximité de l'aéroport international de Bruxelles. En dépit d'un diagnostic tardif, la guérison fut obtenue après un traitement à la chloroquine par voie orale. Ayant exclu tout autre mécanisme de transmission les auteurs concluent que l'infection a été contractée suite à la piqûre d'un anophèle échappé d'un avion. Le problème du paludisme autochtone en Europe Occidentale est discuté et une liste est donnée de 19 cas de paludisme d'aéroport observés depuis 1969.

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