International Journal of Gynecology and Obstetrics (2006) **93**, 225—232

International Journal of
GYNECOLOGY
& OBSTETRICS

www.elsevier.com/locate/ijgo

CLINICAL ARTICLE

Pregnancy outcomes in women with or without placental malaria infection

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Received 19 October 2005; received in revised form 14 February 2006; accepted 28 February 2006

KEYWORDS
Malaria;
Pregnancy;
Placenta;
Histology;
Genome

Abstract

Objective: To assess delivery outcomes in women with placental malaria who presented at public hospitals in Kisumu, a holoendemic region in western Kenya. *Methods:* A cross-sectional study using both histology and molecular biology was conducted with 90 consecutive pregnant women who presented at 3 hospitals during a 2-week period. Data collectors completed standardized questionnaires using each patient's hospital record and physical examination results, and registered birth indices such as weight, head circumference, and weight—head ratio. Malaria infection of the placenta was assessed using a molecular biology approach (for genomic differences among parasite species) as well as histology techniques. Of the 5 histologic classes of placental infection, class 1 corresponds to active infection and class 4 to past infection; class 2 and 3 to active chronic infection; and class 5 to uninfected individuals. *Plasmodium* species typing was determined by polymerase chain reaction amplification of the parasite's genome. *Results:* In newborns at term, low birth weight was directly associated with classes 2 and 4 of placental infection ($P=0.053$ and $P=0.003$, respectively), and differences in birth weight remained significant between the 5 classes ($P<0.001$) even after adjusting for parity and mother's age. *Plasmodium falciparum* was the only detected parasite. *Conclusions:* In Kisumu, infection with *P. falciparum* is an important cause of low birth weight and

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doi:10.1016/j.ijgo.2006.02.021

morbidity when it is associated with histologic classes 2 and 4 of placental infection. Moreover, polymerase chain reaction assays should be supported by ministries of health as an ancillary method of collecting data for malaria control during pregnancy and providing a baseline for future interventions.

1. Introduction

Malaria is the fifth most important cause of illness in sub-Saharan Africa, and *Plasmodium falciparum* stands out as the deadliest of the 4 malaria parasites that infect humans [1,2]. Maternal anemia, intrauterine growth restriction, and preterm delivery, all associated with low birth weight, can complicate malaria infection and contribute to fetal morbidity and mortality [3]. Perinatal mortality caused by malaria is estimated to be between 25 and 80 per 1000 infants per year, although some studies have not demonstrated a clear-cut relationship [4—6]. Besides, malaria can be asymptomatic, and the link between the disease and perinatal morbidity is not always clear in areas of stable endemic malaria where pregnant women have acquired immunity [7—11].

Although malaria parasites do not cross the placental barrier under normal conditions, infection of the maternal—fetal interface may play a key role in determining perinatal morbidity. Since malaria parasites accumulate within the placental tissues, the placenta is the ideal site to study delivery outcomes in women with malaria infection. Placental infection has been associated with up to 35% of preventable cases of low birth weight in areas where the disease is endemic [12,13]. Placental studies are more sensitive and accurate in predicting fetal morbidity than studies based on maternal peripheral blood [14]. The classification of malaria infection is based on the presence or absence of parasites, and of malaria pigment in monocytes or in fibrin deposits [15,16].

The World Health Organization Roll Back Malaria initiative aiming to half the burden of malaria in Africa by the year 2010 is promoting placental malaria studies [17]. In Kenya, malaria in pregnancy is still a major problem, even in districts of low transmission. In line with the Roll Back Malaria program, studies on placental malaria infection and pregnancy outcomes have focused on histologic class and has been conducted in single hospitals [18]. The current study aimed at identifying clinical as well as histopathologic effects of malaria infection during pregnancy.

To investigate the perinatal morbidity and mortality associated with malaria infection in Kisumu, western Kenya, an area of intense, perennial malaria transmission (60—300 infective bites per person annually), a cross-sectional study was carried out with consecutive pregnant women presenting at 3 Kisumu hospitals during the October malaria transmission peak. The study used both histology techniques and a molecular biology approach.

2. Methods

2.1. Study sites and population

The study was linked to the Medical Student Elective Programme of the University of Bristol (UK) and conducted in Kisumu, Kenya. With a population of approximately 300,000, Kisumu is an area of endemic malaria located on the shores of Lake Victoria in western Kenya. Between October 1 and October 15, 2003, pregnant women were enrolled in the study at 3 public hospitals geographically close to each other (New Nyanza Hospital, Kisumu District General Hospital, and Limumba Maternity Hospital).

Areas of endemic malaria are defined as areas with significant annual (seasonal or perennial) transmission, whereas epidemic areas have a distinct interannual variation. Data regarding malaria prevalence in western Kenya were obtained at the following Web site: http://www.mara.org.za. The Kisumu area has intense perennial malaria, with *Anopheles gambiae* as the predominant vector. Malaria transmission occurs throughout the year, with peaks from May through July and October through November. More than 95% of these infections are due to *P. falciparum*, *P. malariae* being responsible for almost all of the remainder. Infections with *P. ovale* are rare. Medical and laboratory technicians were recruited in the town of Kisumu to assist with the study on the basis of their skills, experience, and ability to speak local languages.

2.2. Case definition

Ninety consecutive pregnancies from consenting patients of our study, from all three hospitals, were initially studied. Newborns were weighed to the