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THE FIRST TWELVE MONTHS OF INFANCY AS A TEST FOR THE COMMUNITY INCIDENCE OF INITIAL ATTACKS OF MALARIA*

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We are all aware of the difficulty one meets, in an endemic area, in trying to differentiate a new malarial infection from a recrudescence or relapse. It is our belief that the parasite rate we find each month in the native villages of the Chagres River Valley is very largely due to recrudescence or relapse. On the other hand, a year ago we had an epidemic in which we are reasonably certain that many new infections occurred because there were individuals attacked that had not, over a long period of time, shown parasites in their blood films on our monthly surveys. It seems that our only means of improving a *yardstick*, that can give us some idea of the chances and the time interval likely to be involved in acquiring an initial or a new infection when exposed to a life spent in such villages, is to study the babies that are born and raised there and to determine the age at which they approximate the parasite index for children. In the ordinary course of events, in a highly endemic area, what are the probabilities in the first twelve months of life in regard to initial infections of malaria and to recrudescence or relapse? All of us know that individuals, particularly of a non-tolerant race from a malaria-free region, have acquired malaria as a result of a single weekend spent in a bad area. We also know that the average person often spends a few weeks or months in such a region before malaria is acquired and, rarely, some individuals seem never to acquire the disease. Other features that demand consideration in the first twelve months of life are congenital or hereditary

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malaria, and the effect of the nursing period as a defense against the disease. I am inclined to doubt many of the reported cases of congenital malaria because the chance of contaminating the cord blood with the placental blood is very great, unless the blood films are taken by one fully competent to prepare them. The second reason for doubt is the time interval after birth that is recordpd in many of them, which certainly permits the question of acquirement after birth. Cases of congenital malaria are extremely rare. I have seen only one in my 27 years of tropical experience and that resulted, I am sure, from surgical intervention in a case of placenta previa where the placenta was torn into the cord attachment.

Daleas[1] (1935) reports that Henry's reaction is often positive in the newly born children of Indo-China and he feels that congenital malaria is common though parasites are rarely found in the peripheral blood of the babies.

Wickramasuriya[2] reports six cases of congenital malaria that he considers the result of transplacental passage of parasites.

Schwetz and Peel[3] in a study of 56 women of Central Africa at the time of childbirth report that parasites were found in 6 per cent of the cord blood films and 3.6 per cent of the infant blood films.

Barbosa and Arjona[4] state that congenital malaria undoubtedly exists but that the percentage of cases is very small.

Blacklock and Gordon[5] find that the stagnation of blood in the placenta, with its limitation of oxygen, and the presence of glucose favor the localization and growth of parasites, but they did not find a case of congenital malaria in their study of 26 native women of Sierra Leone.

Wislocki[6] says, "It is unlikely that malarial organisms can enter or penetrate the chorionic syncytium, so that the transmission of malaria from mother to fetus occurs rarely, if at all.

Barber, Mandekos and Rice[7] have very recently reported on 1,575 examinations of infants one year of age or less in malarious villages of Greek Macedonia. In discussing the parasite index of infancy they make the following remarks:

"It is theoretically possible that some inhibitory substance may be transferred from mothers to infants before birth or through lactation ..... The parasite index of 281 infants three or four months old was 45.6 per cent; that of 259 mothers was 59.1 per cent. If very young infants enjoy no natural protection against infection, it is difficult to see how a single infant of this locality could escape infection during an exposure of three weeks; yet we see that the majority of them escape for three months or more, so far as the blood examination could show. What-

ever protection very young infants possess is not complete or universal. We have found two infants infected after 20 and 24 days of life, three after 4 to 5 weeks, and eighteen after 6 to 10 weeks."

My report[8] (1915) on the diagnostic value of the placental blood film in malaria and my continued experience since that date in Central America and Panama have not revealed to me a single case that I would list as congenital malaria save for the one already mentioned in connection with the surgical management of placenta previa. Nevertheless, I should present for your consideration some cases from my autopsy service at Ancon, C. Z. This service extended over a period of ten years and included a large part of the construction period of the Panama Canal when the negro families lived under very primitive conditions, yet I have but four cases of fatal malaria in early infancy to report and all of them are considered acquired (postnatal) infections:

Autopsy 2,866, age 3 weeks, West Indian Negro.
Autopsy 2,000, age 6 weeks, West Indian Negro.
Autopsy 3,756, age 2½ months, West Indian Negro.
Autopsy 3,805, age 8 months, West Indian Negro.

Even the first and second cases mentioned had the time and opportunity to acquire postnatal infections. Cases of congenital malaria are extremely rare, in my opinion, and when they do occur it indicates that some accident or disease has broken the placental barrier. Regardless of the massive infections one finds in the placental blood, the fetal blood is negative for parasites practically without exception.

It is, to me, astounding how few infants under two months of age are found positive for malaria parasites even when such babies are born and reared in camps and rural locations of high endemicity. Because of this, I am forced to wonder whether the mother and the nursing period provide these infants with some natural defensive mechanism and just how much reliance can be placed on the first two months of life as a yardstick for the incidence of initial attacks of malaria. In fact, the normal parasite index for children is not reached in our villages even at the end of twelve months although infections do become very numerous around the twelfth month. It has taken several years to build up a sufficiently large number of babies for analysis but it is possible now to present two groups. The first group[9] is made up of babies found in the Chagres villages and in various other rural parts of Panama before any control was instituted. These babies were not examined monthly for twelve consecutive months. Most of them were examined but once and the age recorded at the date of the survey (*Table 1*).

Table 1

BABY SURVEY

Various Rural Villages in Panama

Malaria Endemic, No Control Measures

Age in Months	Number Examined	Positive for Malaria
1 or less	6	0
1 to 2	7	0
2 to 3	13	3
3 to 4	16	3
4 to 5	7	0
5 to 6	11	5
6 to 7	17	5
7 to 8	16	2
8 to 9	9	6
9 to 10	11	0
10 to 11	12	6
11 to 12	95	20
Total	220	50

The second group consists of babies in our river villages that we were able to survey by the thick blood film method[10] on twelve consecutive months from the time of birth (*Table 2*).

Table 2

BABY SURVEY

120 Examined For The Parasites of Malaria

On 12 Consecutive Months From Birth

Mid-month Examination	Number Positive
First month	0
Second	0
Third	4
Fourth	1
Fifth	1
Sixth	0
Seventh	2
Eight	4
Ninth	4
Tenth	1
Eleventh	2
Twelfth	13
Total	32

During the first six months of life there were 60 examined and 11 found positive, a parasite index of 18.3 per cent.

During the second six months there were 160 examined and 39 found positive, a parasite index of 24.4 per cent.

A total of 50 positives out of 220 examined gives a rate for the twelve months of 22.7 per cent and this is about half what the children's index is expected to be for such places.

In addition to the 32 initial infections recorded there were 3 showing recrudescence, relapse or a new infection as the case may be. The first of these cases had its initial infection during the third month (*P.vivax*) and in the twelfth month revealed the parasites of *P.falciparum*. The second case acquired its initial attack in the fourth month (*P.falciparum*) and showed the same species of parasites in the fifth month. The third case revealed its first infection in the fifth month (*P.vivax* and *P.falciparum*) with the reappearance of one or the other of these parasites on the sixth, seventh and tenth months.

In addition to these two groups of babies, a third group of 66 has been in survey progress for the current year and they range in age from one to twelve months. It is not possible to compare these with the tables just shown since it will require 12 consecutive months' observation and some of them may not remain in the area or may not be present at all surveys. Thus far six of the number (9.1 per cent) have been positive for the parasites of malaria. Two of these had their initial attack in the seventh month, one in the eighth month, one in the ninth month, one in the tenth month and one in the twelfth month. Four of the cases had *P. falciparum* infections and two of them *P. vivax* infections.

DISCUSSION

These babies wear almost no clothing during the first year of life and are therefore exposed to mosquito bites more than other children and adults. They live near uncontrolled anopheline breeding areas and are not living in screened houses. Some of them spend the night hours under mosquito netting but the discipline in the use of the net is poor and one can usually catch more anopheline mosquitoes inside these nets in daytime than in other parts of the house.

In both tables there were no babies showing parasites until the third month. *Table 1* had a rate of 18.3 per cent for the first six months, *Table 2* a rate of 5 per cent for the first six months.

In the second six months, *Table 1* had a rate of 24.4 per cent, *Table 2* a rate of 21.6 per cent.

The total results in the two tables for the parasite index were 22.7 per cent, 26.6 per cent.

Table 2 shows a rate of 9.4 per cent of recrudescence, relapse or new infections for the babies of the Chagres River and the village of New San Juan as compared with a rate of 57.4 per cent among all others in the same areas for the same period of time and for twelve consecutive monthly surveys.

The annual cumulative parasite index for the current

year in these same groups were 9.1 per cent (infants) and 58.2 per cent (all others above twelve months of age).

Perhaps the first two months of infant life are in some way provided a natural defense against the disease but I feel that the remaining ten months of the first year offer us to some extent a helpful guide in regard to the frequency of new infections in an endemic region as compared to recrudescence and relapse. This disease is not so often eradicated by treatment and acquired tolerance as many of us think. The use of transfusions as a therapeutic measure in recent years has developed many surprises in the way of persistence of malarial infection. A malaria patient[11] following his recovery in the tropics spent the next nine years in Paris and was apparently well during this time but he then developed a large abscess and anemia. A transfusion was given him and his donor contracted malaria. The patient himself was then found to be positive for parasites and he had a slight relapse a few days later.

In another case, several ounces of an Italian's blood[12] were given as a transfusion to his anemic infant, which soon afterwards developed quartan malaria. Quartan parasites were then found in the father's blood. The father had no clinical symptoms of malaria but admitted that about once in 12 to 24 months he had a chill which lasted for an hour and was followed by perspiration. He had suffered from malaria as a child, but he had lived in Boston for the previous 20 years.

CONCLUSION

Study of the babies included in these three groups indicates that they can be used to some extent as a measure of new infections in an endemic area. It also shows that congenital malaria must be an extremely rare occurrence. The first two months of infant life appear to be protected either by something inherited from the mother or associated with the nursing period. Whatever this defense may be it is rapidly lost toward the close of the twelfth month.

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