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Thick Blood Smear *vs*. qPCR Diagnostic Accuracy for Malaria Associated with Pregnancy in Colombia

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Abstract

This study aimed to evaluate the accuracy of the Thick Blood Smear (TBS) versus quantitative Polymerase Chain Reaction (qPCR) for the diagnosis of Malaria Associated With Pregnancy (MAP) caused by *P. falciparum* or *P. vivax* in Colombia in its Gestational Malaria (GM), Placental Malaria (PM) and Congenital Malaria (CM) forms as well as to compare its accuracy in different subgroups of pregnant women according to the presence of fever, anaemia and a history of malaria. 829 pregnant women, 579 placentas, 381 samples of the umbilical cord and 221 samples of newborn peripheral blood were evaluated for this diagnostic study. Sensitivity, specificity, predictive values, likelihood ratios and validity index, together with their 95% confidence intervals, were used to evaluate accuracy.

Keywords: Patients • Placentas • Pregnant • qPCR

Introduction

In 2021, there were 247 million new cases of malaria and 619,000 fatalities, according to the World Health Organisation (WHO). Although Pregnancy-Related Malaria (MAP) is not included in this report, other studies suggest that many pregnant women are exposed to the disease. In Colombia, it is anticipated that 59,962 pregnant women will be exposed to malaria by 2022.Congenital Malaria (CM), in which the parasite is found in the new-born's umbilical cord blood or peripheral blood after a vector bite and Placental Malaria (PM), which is caused by the presence of the parasite or hemozoin in placental tissue, are all example of map. In Colombia, it's customary for GM and PM to live together, but not CM. The Centres for Disease Control and Prevention in the United States of America claim that *P. falciparum* map in regions with high transmission creates an immune profile that prevents severe cases and results in a high frequency of asymptomatic malaria, but it also results in *P. falciparum* cytoadhering to the placenta, increasing the risk of PM and CM. Women in low-transmission areas do not develop immunity to malaria, which increases their chance of contracting Plasmodium spp. infection and associated clinical effects. *P. vivax* map is less well understood, however it has a significant risk of PM and CM. Both species in Colombia produce PM with comparable lesions, histological modifications and physiological mediators.

Literature Review

Due to the fact that molecular diagnosis cannot be implemented in rural regions, where the majority of malaria and MAP cases in Colombia occur, the TBS remains the gold standard in Colombia despite its low sensitivity for MAP. A recent analysis found that while TBS has been the industry standard for diagnosis everywhere, its sensitivity is limited and is reliant on elements including the microscopes' training, the calibre of the slides and the reagents. The attainment of elimination goals is further hindered by its low accuracy in low endemic areas, in patients with low parasitemia and in patients with submicroscopic and silent illnesses.

The study population consisted of 829 pregnant women, 579 placentas, 381 samples of umbilical cord blood, and 221 samples of peripheral blood from new-borns collected in community hospitals in Colombia's main malaria-endemic area (the region that reports the highest number of cases in the nation), which is situated in the northwest of the country, specifically in South Córdoba and northwest of Antioquia (Bajo Cauca and Urabá). The samples were gathered from 2010 to 2019 using the same standardised techniques for data collection and malaria diagnosis. The participants were chosen at each hospital's antenatal care programme and the sampling was non-probabilistic. The majority of the time, the samples used to create the GM, PM and CM tests were not from the same individuals (pregnant lady, placenta, umbilical cord, and newborn). This is a result of numerous geographical, cultural, economic and health system-related obstacles that precluded the recruitment of pregnant women and their follow-up till the infant in Colombia. These obstacles included those relating to geography, culture, the economy and the functioning and coverage of antenatal care.

Discussion

As an index test, the TBS was used, and as a reference standard for diagnostic evaluation, qPCR was used. A blood sample was taken and a sizable globular drop was removed from it for the TBS. The drop was evenly applied on a slide sheet to cover an area of about 1 cm by 1 cm, allowed to air dry for 20 minutes, and then stained with a modified version of Romanowsky's stain. The following criteria were used to avoid partial verification bias, spectrum bias and differential verification bias. The TBS and qPCR were applied to the same blood samples (samples taken at the same time), the diagnostic tests were processed independently and blindly (without knowing the results of the other test) and qPCR was used as the reference test in all cases. These patients were chosen to be representative of those receiving the diagnostic test in routine clinical practise.

The TBS had a validity index (properly diagnosed patients) of 83.8%, a Youden index value of 0.55 and a negative probability ratio of 0.45 in the population assessed for GM. Pregnant women who had *P. falciparum* infection, no fever, and no prior history of malaria had the worst outcomes in the subgroup analyses for the negative likelihood ratio and Youden index. However, pregnant women with fever, a history of malaria, and a *P. vivax* infection showed the best results in these two criteria. Women with fever symptoms and *P. vivax*-infected patients had a higher percentage of appropriately diagnosed patients [1-6].

Conclusion

For the diagnosis of GM in pregnant women with *P. vivax* infection, prior

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malaria, and fever (or symptoms), the TBS functioned well in this investigation. It also showed that the TBS's weak case-detection capacity resulted in subpar identification of PM and CM. In order to improve the detection of asymptomatic GM and *P. falciparum* in pregnant women with no history of malaria, optimise the prompt treatment of PM and CM, and prevent the clinical implications of MAP, MAP surveillance, follow-up and control using molecular diagnosis are required.

Acknowledgement

None.

Conflict of Interest

There are no conflicts of interest by author.

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