IISc: new tool to diagnose malaria

Changes can be seen in the blood even when the parasite count is very low due to the bystander effect. | Photo Credit: HANDOUT

By studying the properties of normal red blood cells (RBCs) and parasite-infected RBCs, scientists at the Indian Institute of Science, Bengaluru, (IISc) have developed a new diagnostic tool for early detection of malaria.

Currently, visual microscopic identification of the malarial parasite *Plasmodium* inside red blood cells (RBCs) is used, but the new tool can detect the disease even in RBCs that do not themselves host the parasite but lie near the infected ones. RBCs that lie close to the infected ones appear rigid much like the affected ones and this helps in easy diagnosis. The results were recently published in *Biomedical Journal.*

Optical-tweezers

Blood samples with malaria infections caused by *P. falciparum* and *P. vivax* were collected from the Bangalore Medical College and Research Institute and studied. RBCs were separated out from the blood, and a single RBC was trapped in an optical tweezer trap. In this technique, laser beams are focused at the micron-sized RBC (like tweezers holding the RBC) under a microscope and imaged with a video camera.

The Brownian motion (random movement of particles) of the normal RBC was found to be different from the infected ones.

A photodetector was used to measure this motion of the trapped particle. The researchers quantified the fluctuations using the ‘corner frequency’ measurement. The corner frequency of normal cells was 25 hertz whereas it was 29 hertz for infected cells. The change in frequency was due to the difference in the rigidity of the cells; the infected cells were more rigid compared to the normal ones.

When trapped, the RBC gets folded as it is biconcave in shape and the time taken for folding inside the trap was measured. As the infected cells were more rigid they took about 1.33 seconds to fold whereas normal cells took only 0.8 seconds. A measure of folding time can also be used to determine whether a cell is infected.

Bystander effect

“Only 2-5% of the RBCs host the parasite. But we can see the rigidity in other RBCs in the infected pool also. This is called the bystander effect and it is very helpful in our tweezers study. *P.vivax* infects mainly the immature RBCs (reticulocytes) but due to this effect we could see changes in the mature RBCs not hosting the parasite too. We are yet to understand what exactly is released into the blood stream that causes rigidity even in the non-hosting cells,” says Apurba Paul from the Department of Physics at IISc and first author of the paper.

According to the researchers, the tweezers technique can be used as a general screening tool for all stages of malarial infection. “The technique is very easy and does not require trained personnel as it is fully automated. Very little blood is needed, and it can be drawn at any time of the day. The changes can be seen in the blood even when the parasite count is very low due to the bystander effect,” Paul adds.

A study of nearly 300 people living in different parts of India found that nine single-base variants (single-nucleotide polymorphisms or SNPs) account

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