

## Images in Clinical Tropical Medicine

### Confirming Cerebral Malaria Deaths in Resource-Limited Settings

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A 4-year-old Papua New Guinean girl presented with unresponsive coma (Blantyre coma score = 2) after a short febrile illness. She did not have neck stiffness, a positive Kernig's sign, or other clinical features of bacterial meningitis. Microscopy confirmed a peripheral blood *Plasmodium falciparum* asexual parasite density of 33,960/ $\mu$ L. Despite parenteral artemether and intensive supportive therapy, she died within 6 hours of admission. Supraorbital post-mortem brain biopsy revealed *P. falciparum* in the cerebral microvasculature (Figures 1 and 2).

As part of renewed global efforts to eradicate malaria, the World Health Organization has recently emphasized the need for improved surveillance and case management, including accurate documentation of malaria-related deaths.<sup>1</sup> The supraorbital post-mortem biopsy technique used in this case can be performed rapidly, and it is well-validated, is minimally invasive, and leaves no visible scars.<sup>2</sup> Appropriately stained brain tissue can be examined by microscopy without the need for conventional autopsies and histological examination even in resource-limited settings, thus providing evidence

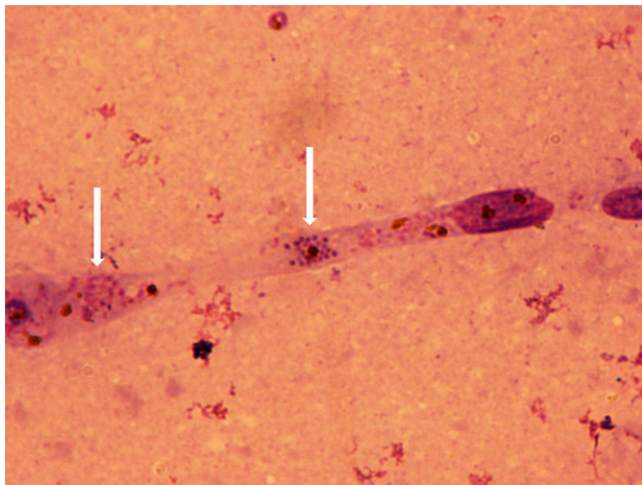


FIGURE 1. Brain smear showing ruptured *P. falciparum* schizonts within a capillary. Giemsa stain immersion (100 $\times$  magnification).

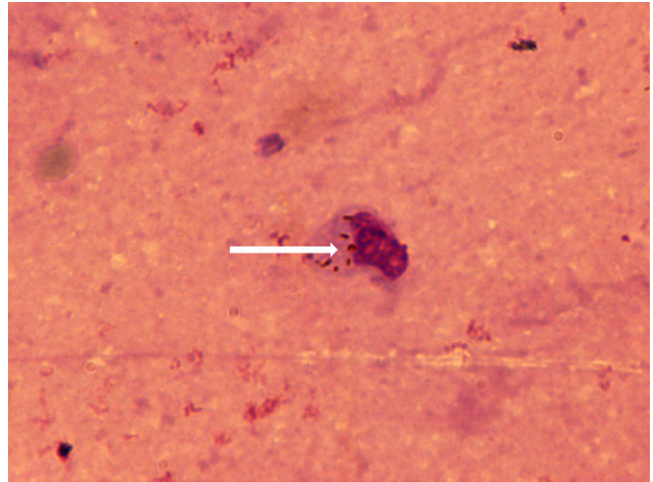


FIGURE 2. A phagocytic microphage containing the malaria pigment (hemozoin) identified on brain smear. Giemsa stain immersion (100 $\times$  magnification).

for a diagnosis of cerebral malaria or perhaps other non-malarial central nervous system disease. Greater certainty regarding the cause of a child's death benefits public health policy makers as well as families and clinicians.

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#### REFERENCES

1. WHO, 2012. *Scaling Up Diagnostic Testing, Treatment and Surveillance for Malaria*. Available at: [http://www.who.int/malaria/publications/atoz/test\\_treat\\_track\\_brochure.pdf](http://www.who.int/malaria/publications/atoz/test_treat_track_brochure.pdf). Accessed June 15, 2013.
2. Milner DA Jr, Valim C, Luo R, Playforth KB, Kamiza S, Molyneux ME, Seydel KB, Taylor TE, 2012. Supraorbital post-mortem brain sampling for definitive quantitative confirmation of cerebral sequestration of *Plasmodium falciparum* parasites. *J Infect Dis* 205: 1601–1606.

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