## Commentary

Malaria continues to be the most significant parasitic disease of human in tropical countries. It has many forms of clinical presentations and complications, including cerebral malaria, anemia, thrombocytopenia, acute renal failure, respiratory distress, jaundice, hypoglycemia, metabolic acidosis, and disseminated intravascular coagulation.[1] Intracranial hemorrhage is a rare complication in malaria, with only 10 cases reported in the available literature.[2-11] There were eight males and two females. Nine of these patients were adults, with ages ranging from 21 to 85 years, and one patient was a 3-year-old female. Infection with *Plasmodium falciparum* was found in eight patients, infection with *Plasmodium vivax* in one patient, and mixed infection with *Plasmodium falciparum* and *Plasmodium vivax* in one patient.

Subdural hematoma was the most common intracranial hemorrhage (five patients), followed by subarachnoid hemorrhage (three patients), extradural hematoma (two patients), intracerebral hematoma (two patients), and falx hemorrhage (one patient). The three cases of subarachnoid hemorrhage were associated with intracerebral hematoma (two cases) and subdural hematoma (one case). One patient with subdural hematoma also presented a subdural empyema. The diagnosis of intracranial hemorrhage was established by computed tomography scan of the head in eight patients and at autopsy in two other patients. There was no clinical evidence of the trauma, fall from height, seizures, bleeding diathesis, intake of anticoagulants or any drug abuse. In the autopsied patients, there were no signs of widespread bleeding diathesis. All patients presented with anemia and thrombocytopenia. The intracranial hemorrhage may have been caused by rupture of a small vessel plugged by red cells in combination with severe thrombocytopenia, as proposed initially by Gall *et al*.[3] In response to *Plasmodium* infection, proinflammatory cytokines are produced, such as TNF-α, which up-regulate endothelial adhesion molecules, promoting platelet and red cell sequestration in small vessels of the brain.[12,13]

Intracranial hemorrhage in malaria is a potentially fatal complication. Six of the 10 patients died, including three of the six patients who had the hematoma surgically drained. These three patients died from infections in the postoperative period. Three other patients recovered after surgery, one of them with mild cognitive impairment. The patient with falx hemorrhage recovered after the treatment with antimalarial drugs, with no signs of permanent impairment at hospital discharge. The article by Kochar DK published in this online issue of Journal of Neurosciences in Rural Practice[14] provides further evidence on this serious hemorrhagic complication in malaria. Intracranial hemorrhages are a medical emergency and require immediate diagnosis and treatment, with evacuation of the hematoma and correction of the associated hematological complications. To avoid such complications, it is imperative to treat each and every malaria patient at the onset of first symptoms. Although intracranial hemorrhage in malaria is almost exclusively caused by *Plasmodium falciparum*, *Plasmodium vivax* may also cause this complication,[11] which confirms the view, initially expressed by Kochar *et al*.[15] in their detailed report of 11 patients, that *Plasmodium vivax* infection may also produce severe malaria.

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