Malaria with Pulmonary Complications

Attapon Cheepsattayakorn1,2, Ruangrong Cheepsattayakorn3

110th Zonal Tuberculosis and Chest Disease Center, Chiang Mai, Thailand
210th Office of Disease Prevention and Control, Department of Disease Control, Ministry of Public Health, Chiang Mai, Thailand
3Department of Pathology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

Corresponding author: Attapon Cheepsattayakorn, 143 Sridornchai, Road Chiangkian Muang, Chiang Mai 50100 Thailand, Tel: 66 53 140773, 66 53 276346; Fax: 66 53 140773, 66 53 273590; E-mail: attaponche@yahoo.com

Received date: September 30, 2014, Accepted date: October 9, 2014, Published date: October 16, 2014

Introduction

Malaria is primarily transmitted by the bite of an infected female Anopheles mosquito to infect humans [1]. Diffuse interstitial edema, pulmonary edema, pleural effusion, and lobular consolidation are presented in severe falciparum malaria [2]. Sanklecha and colleagues reported three cases of childhood falciparum malaria in a family and revealed that two cases demonstrated bilaterally fluffy pulmonary infiltrates whereas the remaining case showed normal chest roentgenogram [3]. All reported patients with sickle cell anemia in their study demonstrated bilaterally pulmonary infiltrates [4]. Chest roentgenographic presentations are usually nonspecific, but they should be recognized in high endemic areas of malaria [4]. A patient with Plasmodium vivax malaria demonstrated diffuse bilateral alveolar opacities which indicated acute respiratory distress syndrome [5]. In India, three cases of ARDS with Plasmodium vivax malaria were also reported and demonstrated one case with bilateral parahilar infiltrates, one case with bilateral diffuse extensive opacities, and another case with bilateral basal ground glass opacities [6]. Pulmonary edema is an universal finding at autopsy [7]. The alveoli are filled parasite-red blood cells, non-parasited red blood cells, neutrophils and pigment-laden macrophages, and laminated periodic acid-schiff (PAS) positive membrane which finally destroys and incorporated the alveolar wall within it in many severe cases [7]. This is associated with abundant edematous fluid, pulmonary vasodilatation, and may have a marked inflammatory infiltrate [7]. Particularly in falciparum malaria, there is hyaline membrane formation in the alveoli that indicates leakage of proteinaceous fluid [7]. In the lungs of severe cases, the majority of blood vessels showed parasite-red blood cell sequestration in the septal capillaries and small blood vessels [8]. Mononuclear cell-pigment laden macrophage were seen admix with parasite-red blood cells in the microvessels of alveolar septa [8]. Platelet- activating factor receptor activation was significant in the pathogenesis of pulmonary damage associated with Plasmodium berghei ANKA strain infection in a mice model, demonstrated in a recent study [9]. Approximately 60% of these infected mice had hypoxemia, dyspnea, pleural effusion, airway obstruction, pulmonary edema, and pulmonary hemorrhage [9]. There is little knowledge about the pathogenesis of malaria-associated acute lung injury and adult respiratory distress syndrome (ARDS) [10]. Increased endothelial permeability and inflammatory mediators may play a significant role, while parasite sequestration may take a minor role that supported by elevation of level of vascular endothelial growth factor found in mice model [10]. Plasmodium falciparum merozoite proteins could increase pulmonary endothelial permeability, while Plasmodium falciparum infected-red blood cells did not reveal the same properties indicating that the effects of the malaria parasites on the pulmonary endothelium are probably mediated the activity of Src-family kinases [10]. In infected mice lungs, increased water content was demonstrated, and contributed to the development of pulmonary edema [10]. DBA2 mice infected with Plasmodium berghei K173 showed proteins and inflammatory cells mainly CD4+ and CD8+ lymphocytes, monocytes and neutrophils accumulated in the lungs of infected mice [10]. Levels of cytokines and chemokines associated with ARDS were measured by Van den Steen and colleagues and revealed an expression of tumor-necrosis-factor-α, interferon-γ, CXCL10 and CXCL11, as well as neutrophils and monocyte chemo-attractant chemokines (CCL2, KC) in the lungs [10]. Subclinical impairment of lung function, such as impaired alveolar ventilation, reduced gas exchange, and increased pulmonary phagocytic activity may be found in uncomplicated malaria [10]. ARDS patients with Plasmodium vivax, Plasmodium ovale, and Plasmodium knowlesi were also reported despite it is the most common complication in Plasmodium falciparum malaria [10]. Two cases of Plasmodium ovale with ARDS were recently reported by Lau and colleagues [11]. Plasmodium falciparum causes the greatest severity and frequency of ARDS and could be partially attributed the resetting an sequestration of parasite-infected red blood cells in the pulmonary microcirculation [10]. The majority of the patients with ARDS have parasitemia [12] in up to 25% in adults, particularly in pregnant women that can up to 29% [13]. In children, ARDS may develop in up to 40% [13]. The association between the heavy parasitemia, white blood cell agglutinates and ARDS in patients with Plasmodium vivax malaria and could be due principally to dysregulation of cytokine production [10]. In patients infected with Plasmodium knowlesi, increased parasitemia in patients infected with Plasmodium knowlesi indicates parasite-specific effects that increase pulmonary capillary permeability, but could contribute to hypoxemia and metabolic acidosis [10]. Disappearance of the K76T mutation in PICRT is related to chloroquine susceptibility [14], while a point mutation in the Plasmodium falciparum chloroquine-resistance transporter (PICRT) gene is responsible for chloroquine-resistant falciparum malaria [15]. The World Health Organization (WHO) recommends oral treatment of piperquine plus dihydroartemisinin as soon as the patient is able to take oral medication but not before a minimum of 24 hours of parenteral treatment [16]. The WHO recommended that intravenous artesunate can be administered preferentially over quinine for the treatment of severe malaria caused by any Plasmodium species in both children and adults [17], which also suggested by Taylor and colleagues [13]. In uncomplicated malaria caused by all Plasmodium species and chloroquine-resistant Plasmodium vivax in both children and adults, oral artemisinin-based combination therapies have also demonstrated equivalent (if not better) [17]. The best way to prevent malaria is insecticide-treated bednets in which insecticide is incorporated into the net fibers [18]. RTS,
S/ASO2, a vaccine has demonstrated promising results in endemic areas [18].

References


