

Ultrasound: An ode to perioperative complicated malaria

Sir,

Plasmodium falciparum (Pf) is responsible for the most fatal form of malaria.^[1] Parturients with malaria exhibit exaggerated symptoms and increased chances of transplacental transfer due to immunosuppression. Moreover, the prevalence and parasite density of Pf are higher in primigravida, as compared to multigravida or nonpregnant patients.^[2]

A 27-year-old (55 kg) primigravida, at 36 weeks of gestation with Pf malaria based on card tests (ParaSight™-F, Becton Dickinson, Sparks, MD) was referred to our obstetric emergency with fetal distress. Nonstress test showed nonreassuring of fetal heart rate (80-110/min). She was immediately taken for emergency cesarean section after an airway examination revealed mouth opening >3 fingers, Mallampati class II, unrestricted temporomandibular joint and no loose teeth or dentures. Her history revealed high-grade fever and altered sensorium for the past 4 days. She was febrile, disoriented, hemodynamically stable and was receiving intravenous artesunate for the past 4 days. Her significant preoperative investigations and abdominal ultrasonography [Figure 1] on the referral card were as shown in Table 1.

On arrival to operation theatre, electrocardiography, pulse oxymetry and noninvasive blood pressure were attached and baseline parameters were recorded (blood pressure-128/84 mmHg, Pulse-128/min and SpO₂ -99% on venturi mask). Her baseline serum glucose level was 102 mg/dL. Rapid sequence induction and intubation were done using 200 mg thiopental, and 85 mg succinylcholine and surgery was started. Simultaneously radial artery and internal jugular vein (IJV) cannulation were tried

under ultrasound ultrasonography [USG]) guidance. USG showed a partial IJV thrombosis [Figure 2], so cannulation was abandoned. Esophageal temperature probe was inserted atraumatically. Anesthesia was maintained with N₂O-O₂ isoflurane (combine minimal alveolar (MAC) concentration of 0.8) mixture until delivery of a 2.10 kg male fetus, which was accomplished in 12 min from induction. After cord separation, 100 µg of fentanyl and 20 mg atracurium was administered intravenously. Oxytocin (25 IU), in titrated infusion, was administered to stimulate uterine contractions. The neonatal data recorded an Apgar score of 5 and 7 at 1 and 5 min respectively, with cord blood pH of 7.22, base deficit of -4.6. Estimated blood loss was 1300 ml, and 1 L of lactated ringers along with one unit of packed red blood cells (PRBC) was transfused. The surgery was uneventful except for a single episode of hypotension, which was managed with 100 mcg of phenylephrine. At the end of the surgery, maternal blood gases, electrolytes and serum glucose levels were within normal limits. Trachea was extubated when patient started following simple commands and shifted to high dependency unit (HDU) for monitoring. Postoperative analgesia was provided with injection paracetamol (1000 mg 6 h). One unit of PRBC, 4 U of fresh frozen plasma

Table 1: Preoperative investigations and abdominal ultrasonography

Hemoglobin	7.8 g/dl
Total leucocyte count	15,000/cumm
Platelet count	48,000/cumm
Total bilirubin	3.4 mg/dl
Alkaline phosphatase	219 IU/L
Prothrombin time	21/(11.7) s
Activated partial thromboplastin time	41/(27) s
Prothrombin index	56%
Abdominal ultrasonography and Doppler study (SonoSite MicroMaxx Portable Ultrasound System, Tacoma, Washington, United States)	35 weeks ± 1 week, singleton pregnancy, adequate liquor, mild splenomegaly and umbilical artery systolic-diastolic ratio of 3.47:1, resistance index 0.71, pulsatility index 1.03

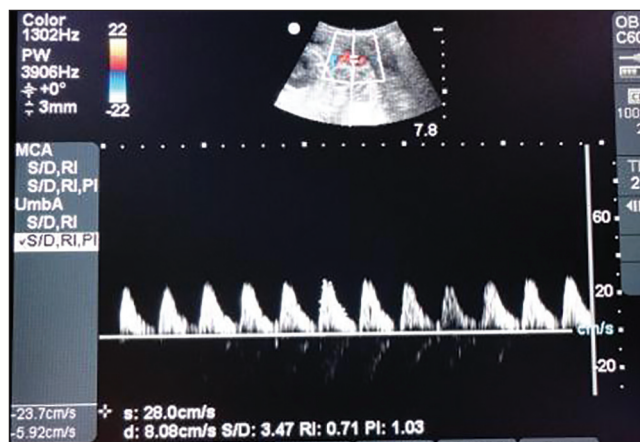


Figure 1: Doppler ultrasound on umbilical art showing systolic-diastolic ratio, resistance index, pulsatility index

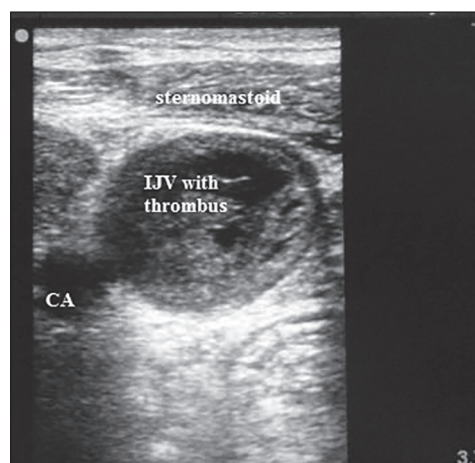


Figure 2: Ultrasonography neck shows partial internal jugular vein thrombosis

and 4 U of platelet concentrates were transfused postoperatively and repeat coagulogram was near normal. Subsequently injection artesunate 120 mg once a day was given for next 2 days. For deep vein thrombosis (DVT), prophylaxis intermittent pneumatic compression device was applied in both legs. With supportive therapy, the intensity of fever reduced on the 2nd postoperative day, and her higher mental function improved. Platelets counts improved, and heparin infusion was started followed by oral warfarin started with international normalized ratio monitoring. Inherited causes of DVT were excluded by blood and serological tests. By the 4th postoperative day, she became afebrile, and her general condition improved markedly. She was shifted out of HDU on the 5th day and discharged after 10 days with oral anticoagulant.

Plasmodium falciparum malaria leads to acute severe complications due to multisystem involvement. Aggregation of infected erythrocytes causes microcirculatory stasis, obstruction, thrombosis and ischemia involving cerebral, hepatic, renal, intestinal and pulmonary circulations resulting in raised intracranial pressure (ICP), hepatic dysfunction, acute kidney injury, gastrointestinal bleeding and pulmonary edema.^[3] Major deep venous thrombosis especially in IJV is rare in malaria.^[4] Pregnancy itself is a hypercoagulable state. Malaria-infected erythrocytes cause altered membrane phospholipid composition, increased von Willebrand factor and other coagulation factors and endothelial damage by malaria-infected red cells leading to increased tissue factors and other cytokines, thereby complicating the hypercoagulable state in malaria infection.^[5] USG is also helpful in screening of deep and superficial venous thrombosis, arterial flow measurement in suspected low perfusion or in gangrene. It also acts as a follow-up monitoring gadget during treatment of DVT. As Pf parasites get sequestered in placenta, their visibility in peripheral blood smear is grossly reduced resulting more false negative test.^[2] Our choice of administering general anesthesia was influenced by the presence of thrombocytopenia, coagulopathy, increased ICP and altered mental status of the patient. Theoretical concerns regarding the introduction of malarial parasites into cerebro spinal fluid from the blood stream also existed with regional anesthesia.^[6] Amongst the general anesthetic drugs, induction agents like thiopental and propofol, etomidate are preferred as cerebroprotective in patients with cerebral malaria whereas the ketamine should be avoided. Among inhalational agent, isoflurane is favored up to one MAC concentration as it causes lesser cerebral vasodilatation and thereby produces less rise of IC. Between muscle relaxants, atracurium or cis-atracurium are the relaxants of choice in the presence of liver and kidney dysfunctions. In analgesics, nonsteroidal antiinflammatory drugs should be avoided in the presence of thrombocytopenia. Paracetamol with cysteine preparation may be suitable in patient hepatic dysfunction.

Interactions between antimalarial drugs and anesthetics also exist. They are as follows:

1. Quinine: Possesses neuromuscular blocking property and enhances the effect of neuromuscular blocking agents by inhibiting phosphodiesterase in skeletal muscle cytosol.^[7] It also aggravates hypoglycemia.
2. Chloroquine: Reduces the effect of neostigmine and pyridostigmine.
3. Mefloquine: Interacts with anticholinergic drugs (like physostigmine) to produce central anticholinergic syndrome.^[8]
4. Dapsone: Can cause intraoperative methemoglobinemia^[9] leading to inaccuracies in pulse oxymetry and the necessitating need of co-oxymetry.
5. Artesunate can cause anaphylaxis.

Hyperpyrexia, decreased oral intake, impaired gluconeogenesis and antimalarial therapy lead to hypoglycemia. Hyperkalemia and hyponatremia are the frequent electrolyte abnormalities. Hyponatremia is commonly dilutional, caused by fluid overload, although excess serum antidiuretic hormone levels are also implicated. Hyperkalemia usually accompanies hemolysis and metabolic acidosis. Renal failure and fluid shift, predisposing to fluid overload and precipitate pulmonary edema.^[6] Careful fluid management is essential to avoid pulmonary edema and cerebral dysfunction, aided by the use of echocardiography (parasternal mid papillary short axis) [Figure 3] and chest ultrasound in perioperative period and inferior vena cava in postoperative period^[10] [Figures 4 and 5]. So knowledge of application of different types of frequency probes like curvilinear, vascular, cardiac is useful in a complicated case of malaria in peri-operative period. Hematological abnormalities and coagulation system dysfunction are common in complicated malaria. Anemia occurs due to dyserythropoiesis, bone marrow suppression, splenic sequestration, red cell dysplasias and hemolysis. Transfusion in affected adults is recommended when hematocrit level drops below 20% of normal.^[11] Pregnancy itself causes thrombocytopenia.^[12] Other causes of thrombocytopenia are platelet activation, splenic sequestration and decreased life-span.^[13] However, gross signs of coagulopathy are rare and functional indices of coagulation that is, prothrombin time and activated partial thromboplastin time are generally mildly deranged.^[14] We emphasize USG should be routinely used for vascular cannulations especially in hyper coagulable, pregnant women with secondary pathology like intravascular volume depletion as in this case to detect the thrombus and prevent further complications.^[4] USG, therefore, a useful tool for performing diagnostic, monitoring, therapeutic invasive procedures in the perioperative period even in emergency.

Plasmodium falciparum adversely affects majority of the organ systems. Proper understanding of the pathophysiology, during the conduct of anesthesia, is important for the anesthesiologists.

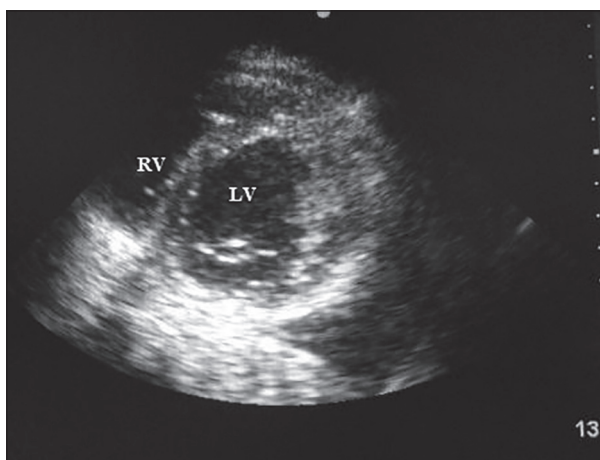


Figure 3: Peri-operative transthoracic echocardiography for hemodynamic monitoring

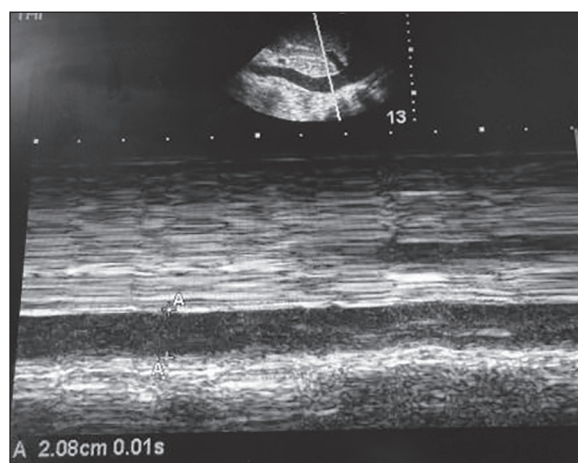


Figure 4: Perioperative inferior vena cava monitoring in fluid management under general anesthesia

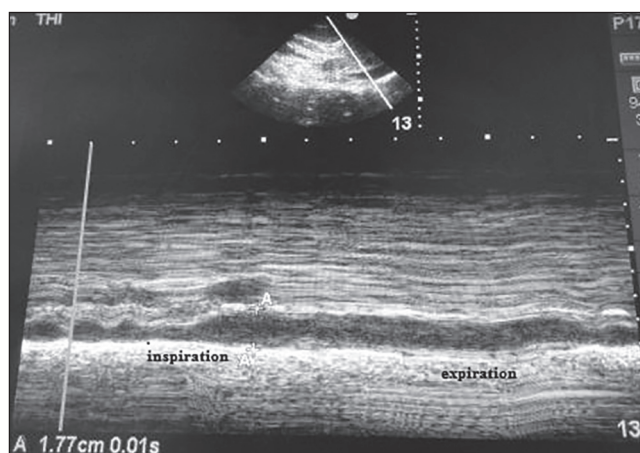


Figure 5: Postoperative inferior vena cava monitoring in fluid management in spontaneous ventilation

General anesthesia should be preferred for cesarean section in cases exhibiting systemic effects of falciparum malaria with expectant approach toward potential complications. Application of peri and postoperative USG is warranted in such cases.

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