CRITICAL CARE

Dengue in Children: Critical Points in Management

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Dengue fever (DF) is endemic and occasionally epidemic in many tropical and subtropical areas inhabited by the mosquito vector *Aedes aegypti*. Infection with Dengue may present with varied clinical manifestations. Significant morbidity and mortality can result if early recognition and monitoring of its severe forms (DHF and DSS) is not done and if appropriate medical intervention is delayed. This article reviews several critical points in the basic evaluation and management of dengue in the pediatric age group and present our current approach in the form of a therapeutic algorithm.

Dengue fever (DF) is endemic and occasionally epidemic in many tropical and subtropical areas inhabited by the mosquito vector *Aedes aegypti.* (1) The more severe forms of the disease, dengue hemorrhage fever (DHF) and dengue shock syndrome (DSS) are major causes of childhood morbidity and mortality. An increasing number of cases have required close monitoring and intensive care management to avoid or treat complications. The key to success is early intervention. It is, therefore, imperative to outline critical points in the basic evaluation and management of pediatric dengue fever.

The purpose of this article is to review relevant information regarding early clinical and laboratory indicators of DF and to discuss our therapeutic approach according to the patient's clinical and laboratory findings. The treatment algorithm we present was developed by a multicenter and multispecialist consensus committee (Figure 1).

Discussion

Dengue fever is an acute illness characterized by fever, retro-orbital headache, myalgia, and frequently rash, nausea, or vomiting, lasting from 5 to 7 days (2). During the febrile phase generalized petechiae can be found, including the soft palate, together with a maculopapular skin rash. Dengue transmission in Puerto Rico can be documented all year, with higher incidence from July to January (3). During seasonal periods any infant or child presenting with fever and such other symptoms should be evaluated for dengue, with a thorough examination and close follow-up with vital signs (**A**). Complete blood cell count (CBC) and initial serum sample for dengue virus isolation or antibody titers should be obtained.

Ambulatory treatment can be given if the platelet count is > 100,000/mm3 and hematrocrit is normal (**B**). Patients should be discharged on oral hydration therapy (glucose and electrolyte solution), analgesics and antipyretics. Salicylates should be avoided because they may cause gastritis and hemorrhage. Dengue convalescent titers, for epidemiological purposes, should be taken one week after the appearance of symptoms.

A small percentage of patients may progress to more severe forms of the disease. The Pan American Health Organization defines DHF as dengue illness accompanied by fever, thrombocytopenia (100,000/mm3 or less), any hemorrhagic manifestation (as mild as a positive tourniquet test), and excessive vascular permeability (hematocrit >20% above baseline value, or pleural or abdominal effusions, or hypoproteinemia or hypoalbuminemia). Dengue shock syndrome (DSS) occurs when these manifestations are accompanied by hypoperfusion (4).

The major pathophysiologic mechanism in DHF and DSS is increased vascular permeability causing plasma loss and third space fluid accumulation (5). Therefore, hemoconcentration is the best indicator that capillary leak and volume depletion are occurring. For the pediatric age group, you may use Dallman's formula (6) to estimate the baseline hemoglobin: baseline hemoglobin = 11.0 + age (in years up to 10 years of age, expressed as decimals).

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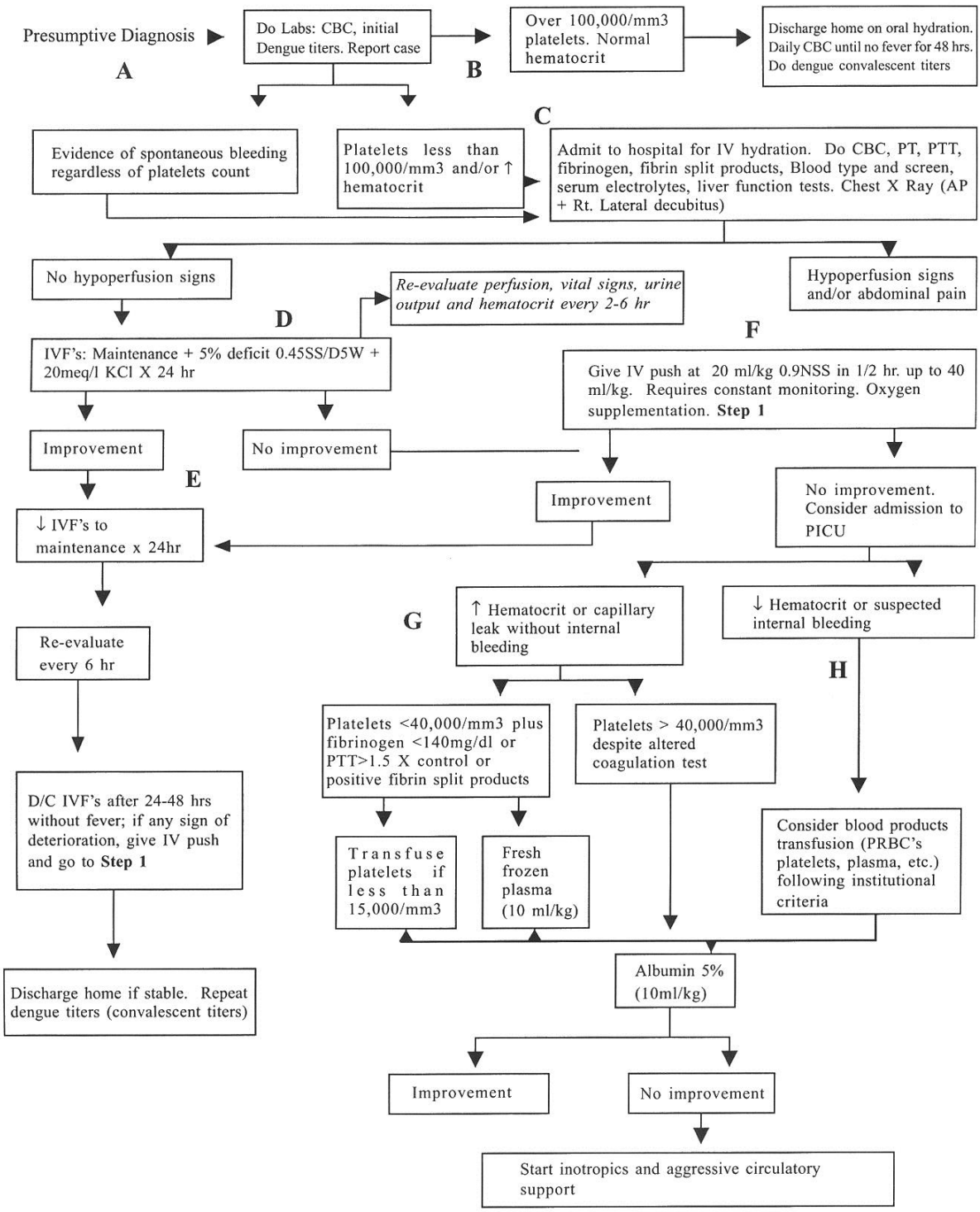
Figure 1. Dengue: Evaluation and Management Algorithm
(Capitals in bold represent the stage of illness)



For example, the expected hemoglobin for an 8 y/o is 11.8g/ml. The hematocrit may be considered to be three times the hemoglobin value. Evidence should be gathered for bleeding abnormalities and third space fluid collection, such as the presence of pleural effusion. Hemoconcentration usually precedes hypotension. Uncorrected hypovolemia will lead to circulatory failure and organ dysfunction, including bleeding and death.

Patients diagnosed with DHF (platelets $\leq 100{,}000/mm^3$, hemoconcentration and bleeding), should be admitted to the hospital for close monitoring and intravenous hydration (**C**). Initial work up should include a CBC, PT, PTT, fibrinogen, fibrin-split products, blood type and screen, serum electrolytes and liver function tests. Patients with DHF/DSS present with leukopenia. Usually have they exhibit a high proportion of atypical lymphocytes that may help to differentiate DHF from a bacterial infection. Electrolyte and metabolic disturbances include metabolic acidosis secondary to tissue hypoperfusion, hyponatremia, and hypocalcemia (particularly in cases in which massive blood products transfusions are given). Hepatic dysfunction signs include hypoglycemia, elevated hepatic enzymes, hyperbilirubinemia and prolonged prothrombin time. Disseminated intravascular coagulation may follow these derangements.

Oxygen therapy should be given to all patients in shock. Evidence should be gathered for third space formation such as the presence of pleural effusion. A chest right lateral decubitus film may be useful for diagnosing early effusions, which are seen in approximately 70 % of DHF/DSS patients (5). Pleural effusions usually do not require drainage unless it is necessary to relieve severe respiratory distress.

Hydration is the most important intervention in the management of patients with dengue. Maintenance intravenous fluids may be calculated using the following caloric formula:

Weight (Kg)	**Total fluids in 24 hours**
0-10 kg	100ml/kg
10-20 kg	1,000 ml + 50 ml/kg for additional kilogram over 10 kg
Over 20 kg	1,500 ml + 20 ml/kg for additional kilogram over 20 kg

For patients exhibiting hemoconcentration, but without evidence of hypoperfusion, maintenance fluids plus 5 percent deficit (50 ml/kg) may be given using 0.45 saline solution in D5W plus 20 mEq/L of potassium chloride (**D**). Intravenous fluids should be rapidly started. Vital signs, urine output, hemoconcentration, and platelet count should be closely followed. Rehydration should be given for not less than 24 hours. If hydration is successful, you will observe a normalization of vital signs, improvement in urine output an no more hemoconcentration. After stabilization of vital signs and hematocrit, intravenous fluids should be decreased to maintenance (**E**). Usually, effective plasma volume is rapidly re-established and the patient increases his urine output. But keep in mind that a patient may deteriorate at any moment, especially 24 to 48 hours after fever subsides.

Hypoperfusion is evidenced by elevated pulse and respiratory rate and poor capillary refill, together with normal or decreased blood pressure, narrowed pulse pressure, and diminished urine output. Severe abdominal pain (due probably to decreased mesenteric perfusion or gut edema from third spacing), persistent vomiting, abrupt decrease in temperature from fever to hypothermia, restlessness, lethargy or fainting are considered warning, if not ominous signs for imminent shock in dengue. In those cases, fluids should be aggressively given at 20 ml/kg 0.9 normal saline solution in less than one hour and repeated once if no improvement is noted (**F**).

If after bolus infusion the patient continues with evidence of hypoperfusion or increasing hematocrit is observed, colloids should be given according to platelet count and coagulation profile status (fresh frozen plasma or 5 percent of plasma protein fraction — plasmanate or albumin — at 10 ml/kg) (**G**). The use of colloids should be considered cautiously due to the risk of pulmonary congestion (7). Inotropic medications should also be started if no improvement is noted.

When a patient shows signs of hypoperfusion together with decreasing hematocrit, internal bleeding should be considered (**H**). Such patient is in critical condition, requiring aggressive blood volume expansion and transfusion of blood products according to needs. The use of intravenous immunoglobulin and corticosteroids in the management of dengue is still in debate (8). Currently, we are not using this approach, even in severe cases.

Resumen

En áreas geográficas tropicales y subtropicales, donde habita el mosquito *Aedes aegypti*, el dengue se considera endémico, alcanzando a veces proporciones epidémicas. El dengue puede presentar manifestaciones clínicas muy variadas que, de no ser reconocidas y tratadas rápidamente, podrían conllevar un aumento en la morbilidad y mortalidad de esta enfermedad. Este artículo describe y discute ciertos momentos críticos en la evaluación y manejo del dengue en pacientes pediátricos, utilizando un algoritmo terapéutico.

Acknowledgement

The authors would like to thank Enid Rivera MD, José G. Rigau-Pérez, MD, José R. Rodríguez-Santana MD, Sandra Somohano MD, Ana Córdova MD, Fernando Rodríguez MD, Gilberto Puig MD, Milagros Pumarejo MD, and Felícita Gotay MD for their enlightening suggestions and helpful discussions in the consensus committee.

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