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 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 hematocrit is normal (B). Patients should be discharged on oral hydration therapy (glucose and electrolyte solution), analgesics and antipyretics. Saliycylates 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).

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

Presumptive Diagnosis

Do Labs: CBC, initial Dengue titer, Report case

A

Over 100,000/mm³ platelets, Normal hematocrit

B

Discharge home on oral hydration, daily CBC until no fever for 48 hrs. Do dengue convalescent titers

C

Evidence of spontaneous bleeding regardless of platelets count

Platelets less than 100,000/mm³ and/or ↑ hematocrit

Admit to hospital for IV hydration. Do CBC, PT, PTT, fibrinogen, fibrin split products, Blood type and screen, serum electrolytes, liver function tests. Chest X Ray (AP + Rt. lateral decubitus)

D

No hypoperfusion signs

IVF’s: Maintenance + 5% deficit 0.45SS/D5W + 20mEq/l KCl X 24 hr

E

Improvement

↓ IVF’s to maintenance X 24 hr

Re-evaluate every 6 hr

F

Improvement

↓ Hematocrit or capillary leak without internal bleeding

↑ Hematocrit or suspected internal bleeding

G

Hypoperfusion signs and/or abdominal pain

Give IV push at 20 ml/kg 0.9NSS in 1/2 hr, up to 40 ml/kg. Requires constant monitoring. Oxygen supplementation. Step I

No improvement. Consider admission to PICU

↓ Hematocrit or suspected internal bleeding

Platelets < 40,000/mm³ plus fibrinogen < 140mg/dl or PTT > 1.5 X control or positive fibrin split products

Platelets > 40,000/mm³ despite altered coagulation test

Transfuse platelets if less than 15,000/mm³

Fresh frozen plasma (10 ml/kg)

Albumin 5% (10 ml/kg)

Improvement

No improvement

Start inotropics and aggressive circulatory support

D/C IVF’s after 24-48 hrs without fever; if any sign of deterioration, give IV push and go to Step I

Discharge home if stable. Repeat dengue titers (convalescent titers)
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 ≤100,000/mm³, 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, hypotension, 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:

<table>
<thead>
<tr>
<th>Weight (Kg)</th>
<th>Total fluids in 24 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 kg</td>
<td>100 ml/kg</td>
</tr>
<tr>
<td>10-20 kg</td>
<td>1,000 ml + 50 ml/kg for additional kilogram over 10 kg</td>
</tr>
<tr>
<td>Over 20 kg</td>
<td>1,500 ml + 20 ml/kg for additional kilogram over 20 kg</td>
</tr>
</tbody>
</table>

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 and 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 — plasmate 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.
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References