

Utilizing the '5 in 1 Magic Touch' CCRTV method for early detection of severe dengue warning signs in pediatric patients: A case study from a Type C Hospital in Indonesia

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Abstract

Background: Dengue fever, prevalent in tropical and subtropical regions, is recognized by WHO as a significant global health threat. Early detection of severe dengue symptoms, especially in resource-limited settings, is critical for patient outcomes. The "5 in 1 Magic Touch - CCRTV" method, which evaluates Color, Capillary Refill Time, Temperature, Pulse Rate, and Pulse Volume, provides a simple yet effective approach to monitor hemodynamics and identify early warning signs of severe dengue.

Case Description: In a case study, a 3-year-old boy was admitted with fever, shortness of breath, weakness, nausea, vomiting, and epigastric pain. On the third day, he entered a critical phase with symptoms of pale extremities, delayed capillary refill time, high fever, and a weak, rapid pulse. Thorax examination revealed severe plasma leakage, pulmonary edema, and right pleural effusion, indicating a pre-shock state. The patient required close clinical monitoring, regular fluid balance management, and frequent blood tests to guide treatment.

Conclusion: The CCRTV assessment method allowed for the early identification of the pre-shock condition, facilitating timely and appropriate intervention. This case highlights the potential of the CCRTV method for improving prognosis in severe dengue cases. The effectiveness of this method warrants further research, particularly in its ability to predict outcomes and improve recovery rates in children with severe dengue.

Keywords: Dengue fever; Severe Dengue; CCRTV Method; Early Warning Sign;

1. Introduction

Dengue fever is a mosquito-borne viral infection that has become a significant public health concern in tropical and subtropical regions worldwide. The disease is caused by the dengue virus (DENV), which is transmitted primarily by *Aedes aegypti* mosquitoes. According to the World Health Organization (WHO), dengue fever is one of the top ten threats to global health, with an estimated 390 million infections occurring annually, of which about 96 million manifest clinically (with any severity of disease). [1]

The clinical presentation of dengue fever can range from a mild flu-like illness to severe forms, such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), which are associated with significant morbidity and mortality. Early detection and management are crucial, particularly in severe cases, where rapid progression to shock can occur due to plasma leakage, leading to organ failure and death if not promptly treated. [2]

In resource-limited settings, the challenge of managing severe dengue cases is further compounded by the lack of advanced diagnostic tools and the need for timely interventions. The "5 in 1 Magic Touch - CCRTV" method, which

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assesses Color, Capillary Refill Time, Temperature, Pulse Rate, and Pulse Volume, offers a simple yet effective approach to quickly evaluate the hemodynamic status of patients and detect early warning signs of severe dengue. This method is particularly valuable in environments where comprehensive diagnostic facilities are unavailable, as it enables healthcare providers to make rapid and informed decisions . [3]

Given the rising incidence of dengue and its severe manifestations, there is a growing need for accessible and reliable methods to improve early detection and management outcomes. This case study underscores the importance of such methods, particularly in settings where resources are constrained, and highlights the potential of the CCRTV method to contribute to better clinical outcomes for dengue patients . [4]

2. Case Report

The patient is a 3-year-old boy who was brought to the hospital with complaints that began two days prior. His primary symptoms included a high fever, shortness of breath, and general weakness. In addition to these, the patient experienced nausea and vomiting 3-4 times per day. The vomiting was accompanied by significant abdominal pain, specifically localized in the epigastric region, which is the upper central part of the abdomen.

2.1. Initial Clinical Assessment

Upon admission, the patient's symptoms were closely monitored. The initial two days were marked by the persistence of fever and gastrointestinal disturbances, indicating a possible systemic infection or inflammatory process. The combination of fever, shortness of breath, and abdominal pain in a pediatric patient raised concerns for several differential diagnoses, including gastrointestinal, respiratory, or systemic infections such as dengue fever, which is prevalent in tropical regions.

2.2. Progression to Critical Phase

On the third day of hospitalization, the patient's condition deteriorated sharply. He entered a critical phase characterized by signs of impending shock, commonly seen in severe cases of dengue fever. The clinical signs observed included:

- **Pallor of Extremities:** The patient's hands and feet became visibly pale, a sign often associated with poor perfusion and the onset of shock.
- **Capillary Refill Time (CRT):** The CRT was noted to be more than 3 seconds, which is a critical indicator of poor peripheral circulation and early shock.
- **Fever:** The body temperature spiked to 39 degrees Celsius, indicating the persistence of a severe febrile condition.
- **Pulse Characteristics:** Palpation of the patient's pulse revealed it to be weak and rapid, consistent with compensatory tachycardia, often seen in shock as the body attempts to maintain adequate cardiac output.

2.3. Diagnostic Findings

Given the worsening clinical picture, a thoracic examination was conducted. The imaging revealed severe plasma leakage, a hallmark of severe dengue fever. This leakage led to:

- **Pulmonary Edema:** Fluid accumulation in the lungs, which explains the patient's shortness of breath and is indicative of a severe systemic inflammatory response.
- **Right Pleural Effusion:** Fluid accumulation in the pleural cavity surrounding the right lung, further complicating respiratory function.

These findings confirmed the suspicion of a severe form of dengue, possibly progressing towards dengue shock syndrome (DSS).

2.4. Management and Monitoring

In response to the critical condition, an aggressive management plan was initiated:

- **Close Clinical Monitoring:** The patient was placed under intensive observation to monitor vital signs, fluid balance, and clinical progression closely.

- **Fluid Management:** Regular fluid balance calculations were essential to avoid fluid overload, which could exacerbate pulmonary edema, while ensuring adequate perfusion. Maintenance crystalloids were administered carefully, tailored to the patient's ongoing fluid losses and needs.
- **Diuresis Monitoring:** Periodic monitoring of urine output was crucial to assess kidney function and the patient's overall fluid status.
- **Laboratory Testing:** Complete blood counts and other relevant blood tests were conducted every 12 hours. This frequent testing was vital to track the progression of the disease and adjust treatment accordingly. The blood tests also helped in identifying any signs of worsening shock, coagulopathy, or other complications associated with severe dengue.

Table 1 Consolidated Laboratory Results during hospitalization

Test	Result (Initial Admission)	Result (Day 1 of Hospitalization)	Result (Day 2 of Hospitalization)	Result (Day 3 of Hospitalization)	Result (Day 4 of Hospitalization)	Result (Day 5 of Hospitalization)	Unit
Haemoglobin	17.10	16.50	12.2	12.2	11.5	11.1	g/dL
Hematocrit	53.30	50.00	38.5	38.5	37.4	35.3	%
Erythrocyte (RBC)	6.77	6.50	4.79	4.79	4.62	4.34	$10^6/\mu\text{L}$
White Blood Cell (WBC)	8.76	9.50	12.44	12.44	7.32	5.71	$10^3/\mu\text{L}$
Platelet Count	134000	150000	63000	63000	103000	119000	$10^3/\mu\text{L}$

Hematological Profile of a Patient Over Five Days of Hospitalization: Monitoring Trends in Severe Dengue Case

The table provides a comprehensive overview of the patient's hematological profile over five consecutive days of hospitalization. It tracks key blood parameters, including hemoglobin levels, hematocrit, erythrocyte (RBC) count, white blood cell (WBC) count, and platelet count.

Key Observations:

- **Hemoglobin and Hematocrit:** Both levels showed a gradual decrease over the five days, starting from elevated levels at admission and moving closer to the lower end of the normal range. This decrease might reflect the body's response to the disease and ongoing treatment, possibly related to fluid resuscitation and the resolution of hemoconcentration.
- **Erythrocyte (RBC) Count:** The RBC count decreased from Day 1 to Day 5, indicating a potential reduction in red cell mass, which could be due to the disease process or a dilutional effect from fluid therapy.
- **White Blood Cell (WBC) Count:** The WBC count initially rose on Day 2, likely due to an inflammatory response, before gradually declining by Day 5. This trend could indicate the body's response to the infection and its eventual control as the patient's condition stabilizes.
- **Platelet Count:** A significant drop in platelet count was observed initially, which is characteristic of dengue fever. However, by Day 5, there was a notable recovery in platelet levels, suggesting an improvement in the patient's condition.

Overall, the trends in this table suggest a patient experiencing severe dengue with initial critical abnormalities in blood parameters, followed by gradual stabilization and recovery by the fifth day of hospitalization.

3. Discussion

The case presented illustrates the clinical course of a pediatric patient diagnosed with severe dengue, characterized by significant hematological changes over a five-day period of hospitalization. This discussion aims to systematically analyze the clinical findings, the management strategies implemented, and the implications for future treatment of similar cases. Dengue fever, particularly in its severe form, is known for causing marked changes in hematological parameters. These include hemoconcentration, thrombocytopenia, and leukopenia, which are critical markers for assessing disease severity and progression. The data from the patient's lab results show a progressive decrease in hemoglobin and hematocrit levels, which is consistent with the dilutional effect following aggressive fluid therapy. Initially elevated due to plasma leakage, these levels normalized as the patient stabilized, suggesting effective management of the critical phase of dengue. [5,6]

3.1. Pathogenesis and Risk Factors

3.1.1. Pathogenesis

Severe dengue is primarily driven by the immune response of the host, which can result in severe plasma leakage, bleeding, and organ impairment. The pathogenesis of severe dengue involves complex interactions between the virus, the host's immune system, and various other factors. The key mechanisms include antibody-dependent enhancement (ADE), where pre-existing, non-neutralizing antibodies from a previous dengue infection enhance the virus's ability to infect cells. This phenomenon leads to increased viral replication and a more severe immune response. [7]

The exaggerated immune response triggers the release of pro-inflammatory cytokines and chemokines, contributing to increased vascular permeability. This vascular leakage is the hallmark of severe dengue, leading to hypovolemia and shock if not managed promptly. Additionally, the depletion of platelets, due to direct viral effects and immune-mediated destruction, contributes to the bleeding tendencies seen in severe cases. . [8]

3.1.2. Risk Factors

Several risk factors have been identified that increase the likelihood of developing severe dengue. These include: . [9]

- **Secondary Infection:** Patients with a second dengue infection are at a higher risk of developing severe dengue due to ADE.
- **Age and Sex:** Children and elderly individuals, as well as females, have been shown to have a higher risk of severe disease.
- **Genetic Predisposition:** Certain genetic markers have been associated with an increased risk of severe dengue, including variations in the genes related to the immune response.
- **Viral Factors:** The strain and serotype of the dengue virus can influence the severity of the disease. Some serotypes and strains are more likely to cause severe disease than others.

3.2. Clinical Presentation and Diagnostic Challenges

3.2.1. Clinical Presentation

Severe dengue, also known as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), manifests with a wide range of clinical symptoms that can complicate the diagnostic process. The clinical presentation often includes high fever, severe headache, retro-orbital pain, myalgia, arthralgia, rash, and mild bleeding manifestations such as petechiae and mucosal bleeding. As the disease progresses, severe complications such as plasma leakage, severe bleeding, and organ involvement may develop, leading to hypovolemic shock (DSS), which is a critical and life-threatening condition. [10]

The critical phase usually occurs around the time of defervescence (when the fever subsides), often misleading clinicians, as the reduction in fever might be interpreted as an improvement. However, this is the period when patients are at the highest risk of developing severe dengue. The warning signs that indicate the progression to severe dengue include persistent vomiting, severe abdominal pain, lethargy, restlessness, and a rapid drop in platelet count. The progression to severe disease can be rapid, necessitating close monitoring and early intervention.[11]

3.2.2. Diagnostic Challenges

The diagnosis of severe dengue can be challenging due to its nonspecific clinical symptoms that overlap with other tropical diseases such as malaria, leptospirosis, and typhoid fever. The initial phase of dengue often resembles a benign viral illness, making early identification of severe cases difficult. Laboratory diagnosis involves serological tests, such as the detection of dengue-specific IgM and IgG antibodies, and molecular techniques like reverse transcription-polymerase chain reaction (RT-PCR) for detecting viral RNA.[12]

However, these diagnostic methods have limitations. Serological tests may not differentiate between primary and secondary dengue infections, and false positives may occur due to cross-reactivity with other flaviviruses. RT-PCR, while specific, is expensive and not always readily available in resource-limited settings. Additionally, the dynamic nature of hematological parameters, such as hematocrit, platelet count, and white blood cell count, requires continuous monitoring, which is not always feasible in all healthcare settings.[12]

3.3. Management and Therapeutic Strategies

Management Overview: The management of severe dengue, especially in the presence of warning signs, is critical and requires a systematic and vigilant approach. The primary goal is to prevent the progression to dengue shock syndrome (DSS) and reduce mortality. Early recognition of warning signs, such as persistent vomiting, severe abdominal pain, lethargy, and a rapid decline in platelet count, is crucial in determining the appropriate therapeutic strategies. [13]

Fluid Management: Fluid management is the cornerstone of treatment in severe dengue with warning signs. The primary objective is to maintain adequate intravascular volume to prevent shock while avoiding fluid overload, which can lead to complications such as pulmonary edema or pleural effusion. The World Health Organization (WHO) recommends a stepwise approach to fluid therapy, beginning with isotonic crystalloids for initial resuscitation. The amount and rate of fluid replacement are carefully titrated based on the patient's clinical status and frequent monitoring of hematocrit levels, urine output, and vital signs. [14]

In patients showing signs of shock, rapid fluid resuscitation is required, followed by a reassessment every 1-2 hours. If the patient stabilizes, the fluid rate is gradually reduced to maintenance levels. If signs of shock persist despite adequate fluid replacement, colloids such as Dextran or Hydroxyethyl starch may be considered. [14]

Monitoring and Supportive Care: Close monitoring in a high-dependency or intensive care unit (ICU) setting is often necessary. Continuous monitoring of vital signs, capillary refill time, and oxygen saturation helps in assessing the response to treatment. Hematocrit, platelet count, and liver function tests are regularly monitored to guide further management. In severe cases, blood transfusions may be required to manage significant bleeding or coagulopathy.

Supportive care, including the management of pain and fever, is also essential. Antipyretics such as paracetamol are recommended for fever control, while non-steroidal anti-inflammatory drugs (NSAIDs) should be avoided due to their potential to exacerbate bleeding. [15]

Use of Adjunctive Therapies: Although the primary management revolves around fluid therapy, adjunctive therapies have been explored in severe dengue. The use of corticosteroids, immunoglobulins, and antiviral agents has been studied, but evidence supporting their efficacy remains limited and controversial. Current guidelines do not recommend routine use of these agents outside of clinical trials. [16]

Outcome and Prognosis: With timely and appropriate management, the prognosis of severe dengue can be significantly improved. However, delays in recognizing warning signs or inappropriate fluid management can lead to poor outcomes, including irreversible shock, organ failure, and death. Therefore, education and training of healthcare providers in dengue-endemic areas are critical to improving patient outcomes. [16]

4. Conclusion

The rapid onset of severe symptoms in this pediatric patient highlights the critical nature of dengue fever, especially in its severe forms. The combination of clinical signs, diagnostic findings, and the systematic approach to management emphasizes the importance of early detection and prompt intervention in improving patient outcomes. The case also underscores the need for vigilant monitoring in the critical phases of dengue, particularly in children, who are more vulnerable to rapid deterioration.

This detailed account illustrates the complex and dynamic nature of managing severe dengue in a pediatric patient, requiring a multidisciplinary approach and constant adaptation to the patient's evolving clinical status.

Compliance with ethical standards

Disclosure of Conflict of interest

No conflicts of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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