" Dengue Shock Syndrome: A Literature Review "

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Abstract

Dengue Shock Syndrome (DSS) represents a perilous complication critical complication of Dengue Hemorrhagic Fever associated with high mortality. DSS is characterized by circulatory failure, presenting as a rapid, weak pulse, narrow pulse pressure, or hypotension, and can rapidly progress, leading to severe complications and death if not treated correctly. The intricate pathogenesis involves increased vascular permeability, myocardial dysfunction, and dehydration, leading to relentless multiorgan failure. The onset of shock in dengue is abrupt, and its progression is unyielding. Diagnosis primarily relies on clinical assessment, supported by serology and viral material identification. Unfortunately, specific methods for predicting outcomes and progression are lacking. Effective management necessitates close monitoring, early detection, and timely and aggressive fluid resuscitation, primarily using normal saline, Ringer lactate, or colloid solutions. Notably, corticosteroids and intravenous offer no proven benefits, and as of now, no specific therapy has demonstrated efficacy in improving survival.

Keywords: Dengue; shock; DHF; DSS

1. Introduction

Dengue virus infection poses a significant threat to approximately 20 million individuals annually in tropical and subtropical regions (Rajapakse, 2011). With a mortality rate ranging from 1–2%, its impact is substantial. The disease spectrum encompasses a broad range of manifestations, from asymptomatic or mild cases to varying degrees of thrombocytopenia and vascular leakage typical of dengue hemorrhagic fever (DHF), culminating in severe shock syndrome and multiorgan failure (Halstead, 2007). Around 400 million people are infected with dengue fever every year. Approximately 100 million people are infected and 40,000 die from severe dengue fever (CDC, 2019). In the face of such clinical diversity, understanding the pathogenesis and identifying effective management strategies become crucial in mitigating the impact of this formidable infectious threat.

2. Dengue Shock Syndrome

2.1 Definition

Dengue shock syndrome (DSS) is characterized as the third and fourth stages in the progression of Dengue Hemorrhagic Fever, marked by evidence of circulatory failure, such as a rapid, feeble pulse and narrow pulse pressure (≤20 mmHg [2.7 kPa]), or hypotension related to age, restlessness, and cold, clammy skin. Without appropriate treatment, patients with dengue can swiftly transition into DSS, leading to severe complications and potential fatality (CDC, 2009).

The occurrence of shock syndrome in dengue infection poses a hazardous complication associated with a notable mortality rate. The development of severe dengue fever is linked to a secondary infection involving a different serotype of the virus. The interplay of increased vascular permeability, myocardial dysfunction, and

dehydration significantly contributes to shock development, resulting in multiorgan failure. The onset of shock in dengue fever is often abrupt, and its progression is unremitting (Rajapakse, 2011).

2.2 Epidemiology

In 2019, Indonesia reported 138,127 cases of dengue fever, a notable increase from the 65,602 cases reported in 2018 (Kemenkes, 2019). By the close of 2013, dengue fever had propagated to 438 regions, encompassing 88% of the 497 districts/cities in Indonesia (Dinkes Jatim, 2020).

Age emerges as a significant factor influencing the incidence of Dengue Shock Syndrome (DSS), as individuals aged 0 to 7 years exhibited a higher incidence (63.4%) compared to the control group (58.5%). Conversely, for those aged 8 to 14 years, the incidence was lower in cases (36.6%) than in the control group (41.5%) (Silvarianto, 2013).

Research by Anders et al. (2011) in Vietnam indicates that children aged 6–10 years face the highest risk of Dengue Shock Syndrome (DSS), with mortality being highest in younger children and decreasing with age. Another study by Irawan Prasetya et al. (2017) highlights that the majority of Dengue Hemorrhagic Fever (DHF) and DSS cases occurred in individuals aged ≤15 years, with a nearly equal distribution between genders; 47.1% men and 52.9% women. Notably, children aged 5-9 years are at a higher risk of DSS compared to other age groups.

While males are overrepresented among dengue cases, girls exhibit a higher risk of developing DSS (Rajapakse, 2011). Another study by Salsabila, Shodikin, & Rachmawati (2017) found that male patients had a 0.615 lower risk than females of contracting Dengue Shock Syndrome (DSS).

2.3 Pathogenesis

The secondary heterologous infection hypothesis, as outlined in Sukohar's (2014) work, posits that an individual may experience dengue fever after an initial infection and subsequent exposure to a different strain of the dengue virus within a specified timeframe, estimated at 6 months to 5 years. The primary pathophysiological distinctions between dengue hemorrhagic fever and dengue fever involve heightened blood vessel wall permeability, reduced plasma volume, hypotension, thrombocytopenia, and hemorrhagic diabetes (WHO, 2011). Following a second infection with a distinct dengue virus type in a patient with low anti-dengue antibody levels, there is a rapid anamnestic antibody response, leading to the proliferation and transformation of immune lymphocytes, generating elevated levels of anti-dengue IgG antibodies. The abundant presence of the virus facilitates its replication. Consequently, an antibody antigen complex forms, activating the complement system. The ensuing release of C3a and C5a, prompted by the activation of C3 and C5, induces heightened blood vessel wall permeability, resulting in plasma seepage through the endothelium. In severe cases, there can be a reduction in plasma volume exceeding 30%, persisting for 24-48 hours. Inadequately treated shock can lead to tissue anoxia, metabolic acidosis, and ultimately, death (Sukohar, 2014).

2.4 Manifestations and Diagnosis

WHO diagnostic criteria for dengue shock (WHO, 2005).

Features of dengue hemorrhagic fever

- Fever, or history of acute fever, lasting 2–7 days, occasionally biphasic
- Hemorrhagic tendencies, evidenced by at least one of the following
    - A positive tourniquet test
    - Petechiae, ecchymoses, or purpura
    - Bleeding from the mucosa, gastrointestinal tract, injection sites, or other locations
    - Hematemesis or melena
- Thrombocytopenia (100000/mm3 or less)

- Evidence of plasma leakage due to increased vascular permeability, manifested by at least one of the following;
    - A rise in hematocrit ≥20% above the average for age, sex and population
    - A drop in hematocrit following volume replacement equal to or greater than 20% of the baseline
    - Signs of plasma leakage such as pleural effusion, ascites or hypoproteinemia

All four of the above PLUS evidence of circulatory failure, manifested by

- Rapid weak pulse, and
- Narrow pulse pressure (<20mmHg) OR
- Hypotension for age, and
- Cold, clammy skin, and restlessness

Confirmation of dengue infection typically involves serological testing or the identification of dengue viral material in the blood using RT-PCR. Commonly employed diagnostics include Dengue-specific IgG and IgM ELISA. However, these tests lack precision in predicting the likelihood of dengue shock development. Currently, no biochemical assays are available for anticipating shock, primarily relying on clinical judgment. Indicators such as hemoconcentration and declining platelet counts serve as precursors to the onset of shock. Radiological methods, including chest radiography for pleural effusions, echocardiography for pericardial effusions, and ultrasonography for ascites, aid in detecting fluid extravasation due to vascular leakage. The presence of fluid around the gallbladder, accompanied by gallbladder wall thickening, has been identified as an association with shock. Patients experiencing shock exhibit various metabolic abnormalities, including lactic acidosis, elevated transaminases, and increasing levels of serum creatinine and blood urea. The assessment of pulse oximetry and arterial blood gas analysis, revealing hypoxia, may signal the development of pulmonary edema, whether of cardiogenic or non-cardiogenic origin. Echocardiography, employed early in suspected impending shock cases, stands as the primary diagnostic tool for identifying myocardial dysfunction (Rajapakse, 2011).

2.5 Management

Close vigilance is essential due to the swift onset of shock, necessitating transfer to an intensive care unit (ICU). The patient must undergo meticulous observation with continuous or, at a minimum, 15-minute interval monitoring of pulse, blood pressure, and respiration. Pulse oximetry should be employed to monitor oxygen saturation, and oxygen administration via a face mask is advised. Comprehensive blood tests, including grouping, cross-matching, blood urea, serum electrolytes, liver function tests, full blood count, prothrombin time, and c-reactive protein, are imperative. Paracetamol may be employed for fever control. Timely and assertive fluid resuscitation stands as the sole proven treatment for Dengue Shock Syndrome (DSS). Options for volume expansion encompass normal saline, Ringer lactate, 5% glucose diluted 1:2 or 1:1 in normal saline, plasma, plasma substitutes, or 5% albumin. Research findings indicate no discernible advantage of colloids over Ringer lactate in cases of moderate shock. For severe shock cases, neither starch nor dextran has exhibited a clear benefit. Intravenous bolus administration of fluids within a 20-minute timeframe, and if necessary, repeated doses of plasma, plasma substitutes, or albumin up to a total of 20–30 ml/kg of colloid, is recommended for persistent shock. Fresh whole-blood transfusion may be necessary in cases of persistent shock, particularly with decreasing hematocrit levels. Proper fluid resuscitation in DSS has demonstrated mortality rates of <0.2%. Fluid resuscitation goals involve enhancing central and peripheral circulation, improving end-organ perfusion, and achieving stable consciousness levels, urine output ⩾0.5 ml/kg/hour, and decreased metabolic acidosis. Platelet transfusions are generally reserved for cases with severe hemorrhagic manifestations or critically low

platelet counts. Despite early suggestions of potential benefits, subsequent research has failed to establish the efficacy of corticosteroids in terms of survival or hemodynamic improvement in DSS (Rajapakse, 2011).

In instances of shock, a swift intravenous bolus of fluids at a rate of 10–20 ml/kg body weight within less than 20 minutes is recommended. If shock persists and there is a rise in hematocrit, a rapid bolus of plasma, plasma substitutes, or albumin is advised and can be repeated to achieve a total dose of 20–30 ml/kg of colloid if necessary. Should shock persist, especially with a decreasing hematocrit, a fresh whole-blood transfusion of 10 ml/kg may become necessary. Effective use of fluid resuscitation in Dengue Shock Syndrome (DSS) has demonstrated mortality rates below 0.2% (Rajapakse, 2011). The objectives of fluid resuscitation encompass enhancing central and peripheral circulation, mitigating tachycardia, improving blood pressure, pulse volume, maintaining warm and pink extremities, and achieving a capillary refill time of less than 2 seconds. Additionally, fluid resuscitation aims to enhance end-organ perfusion, ensuring a stable conscious level (greater alertness or reduced restlessness), urine output of at least 0.5 ml/kg/hour, and reducing metabolic acidosis (Soegijanto and Chilvia, 2013).

Patients experiencing severe hemorrhagic symptoms or having notably low platelet counts are typically administered platelet transfusions. The increase in circulating platelet levels following transfusion is directly proportional to the quantity of platelets infused and inversely related to the severity of shock. The World Health Organization's (WHO) guidelines for managing dengue do not address the use of corticosteroids. Initial studies indicated potential advantages of corticosteroids in treating dengue shock, particularly in a controlled study involving children with Dengue Shock Syndrome (DSS) treated with hydrocortisone. This study demonstrated a statistically significant reduction in mortality with corticosteroids for children aged 8 years and older, although this benefit was not observed in younger children. Among the corticosteroid-treated group, nine out of 11 children survived, while all children in the saline and plasma replacement group died. Subsequent investigations into corticosteroids in dengue have uniformly failed to demonstrate any advantages in terms of survival or hemodynamic improvement, leading to the consensus that there is no supporting evidence for the use of corticosteroids in DSS (Rajapakse, 2011).

3. Conclusion

Dengue Shock Syndrome (DSS) emerges as a perilous complication in Dengue Hemorrhagic Fever, marked by circulatory failure, presenting as a rapid, weak pulse, narrow pulse pressure, or hypotension. Its swift progression leads to severe complications and heightened mortality without proper intervention. The complex pathogenesis involves increased vascular permeability, myocardial dysfunction, and dehydration, culminating in relentless multiorgan failure. Diagnosis relies on clinical evaluation supported by serology and viral material identification, lacking specific predictive methods. Effective management mandates vigilant monitoring, early detection, and assertive fluid resuscitation, primarily employing select solutions. Remarkably, corticosteroids interventions lack proven benefits, and current therapies show no efficacy in enhancing survival.

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