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Original Article

The relationship between pleural effusion index and mortality in children with dengue shock syndrome

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Abstract

Background Dengue shock syndrome (DSS) mortality rate is still high. The extent of plasma effusion in dengue shock syndrome can be identified in the right lateral decubitus position on chest x-ray, and quantified by the pleural effusion index (PEI). It is thought that PEI value can be used to predict DSS mortality in children. Pleural effusion in DSS patients can cause respiratory failure and death.

Objective To determine the relationship between PEI and mortality in children with DSS.

Methods This cross-sectional, retrospective study was held in the Dr. Kariadi Hospital, Semarang, Indonesia. Data was taken from medical records of pediatric intensive care unit (PICU) patients with DSS from January 2009 to January 2011. DSS diagnosis was confirmed by clinical and radiological manifestations. PEI diagnosis was established by the presence of fluid in the pleural cavity on pulmonary radiological examinations. X-rays were interpreted by the radiologist on duty at the time. Chi square and logistic regression tests were used to analyze the data.

Results There were 48 subjects with DSS, consisting of 18 males (37.5 %), and 30 females (62.5%). Twenty-nine subjects (60.4%) survived and 19 (39.6%) died. One patient (2.1%) had PEI <6%, 4 (8.3%) had PEI 6-15%, 17 (35.4%) had PEI 15-30%, and 26 (54.2%) had PEI > 30% on their x-rays. The mortality rate of DSS with PEI 15-30% was 11.8% (95% CI 0.021 to 0.564; P<0.005) and PEI >30% was 65.4 % (95% CI 3,581 to 99,642; P <0.005).

Conclution PEI >15% was a risk factor for mortality in children with DSS. **[Paediatr Indones. 2012;52:239-42]**.

Keywords*: pleural effusion index, mortality in dengue shock syndrome*

Dengue hemorrhagic fever is an important cause of morbidity in Asian children, and dengue shock syndrome causes a significant number of childhood deaths. DSS is characterized by a massive increase in systemic capillary permeability with consequent hypovolemia.[1]

WHO defines DSS as DHF plus signs of circulatory failure manifested by rapid and weak pulse, narrow pulse pressure (≤ 20 mmHg) or hypotension for age, prolonged capillary refill, cold and clammy skin and restlessness. Onset of shock is acute and occurs at the time of defervescence, usually after 2-5 days of fever. During shock, patients may have subnormal body temperature, cold and clammy skin, as well as rapid and feeble pulse. Pleural effusion and ascites measurements may be used to predict the development of DSS.[2-5]

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Pleural effusion occurs in the phase of plasma leakage, causing decreased chest compliance and reduced functional residual capacity. Furthermore, pleural effusion causes hypoxemia and increased breathing effort. Clinical manifestations caused by pleural effusion depend upon the volume of pleural fluid, in addition to lung parenchymal pathology, such as acute respiratory distress syndrome.[6]

Right lateral decubitus position on chest x-ray is used to evaluate pleural effusion. The degree of plasma leakage may be quantified by the PEI. PEI is calculated to be 100% times the maximum width of the right pleural effusion, divided by the maximal width of the right hemithorax.[7]

The objective of this study was to evaluate the use of PEI values to predict mortality in DSS in children.

Methods

The retrospective, cross-sectional study was held in the Dr. Kariadi Hospital, Semarang, Indonesia from January 2009 to January 2011. Data was taken from medical records of children with DSS in the PICU who fulfilled the inclusion criteria. Eligible subjects were children aged 1-14 years with diagnoses of dengue syndrome (DS) according to WHO criteria, and were not having septic or shock condition. DSS diagnosis was confirmed by clinical and radiological manifestations. PEI was assessed from lateral decubitus position on chest x-rays and calculated by the formula A / B x 100% **(Figure 1)**.[8]

Radiological examination results were reviewed by the on-duty radiologist. We analyzed data using Chi square and logistic regression analyses with SPSS software version 17.0.

Results

There were 48 PICU cases of DSS from January 2009 to Januari 2011, consisting of 18 males (37.5%) and 30 females (62.5%). Twenty-nine subjects survived (60.4%), and 19 died (39.6%), as shown in **Table 1**. **Table 2** shows the PEI groupings based on x-ray findings.

The relationship of PEI to death was observed in PEI values of greater than 15%, with a statistically significant association in the two highest PEI categories, 15-30% and > 30% **(Table 3).**

Discussion

This study was conducted to determine the relationship of plasma leakage severity, as measured by PEI, to mortality in DSS patients.

Subjects' genders in our study were 37.5% male and 62.5% female. A 1987 Singaporean study[10] reported a higher number of cases of men than women with a ratio of 1.9 : 1, while a 1993 Thai[11] study reported girls to be two times more frequently hospitalized due to dengue.[10] In a 1990 Indonesian study, cited from Supriatna MS, there was no significant difference between males and females in the number of DHF cases and shock events.[10,12]

From a total of 48 DSS patients, 19 died (39.6%) and 29 lived (60.4%). Nationally, DHF mortality rate was reported to be low (2.5% in 1997) and remains to be below 3%.[13] In Semarang in 2004, there were 1621 dengue cases with an incidence rate of 11.8 per 10,000 population and a case fatality rate of 0.43%. DSS mortality in the Dr. Kariadi Hospital PICU decreased from 12% in 2002 to 10.8% in 2004.[12]

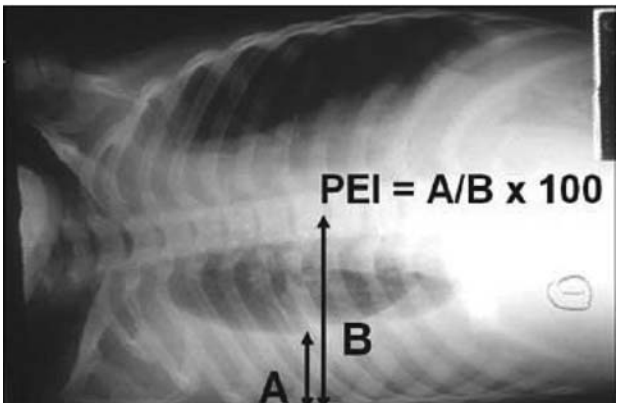

Figure 1. Pleural effusion index calculation[8]

Table 1. Characteristics of subjects

Characteristics	n = 48	%
Sex		
Male	18	37.5
Female	30	62.5
Mortality status		
Survived	29	60.4
Died	19	39.6

DSS is defined as DHF with signs of circulatory failure, including narrow pulse pressure (20 mm Hg), hypotension, or frank shock. The prognosis in DHF/DSS depends on prevention or early recognition and treatment for shock. In hospitals with experience in treating DSS, the case fatality rate in DHF may be as low as 0.2%. Once shock has set in, the fatality rate may be much higher (12% to 44%).[14]

Table 2. PEI groupings based on chest x-ray findings

PEI	n = 48	%
< 6%	1	2.1
6-15%	4	8.3
15-30%	17	35.4
>30%	26	54.2

Table 3. Relationship of mortality rates to PEI

PEI	Death n (%)	OR	95% CI	P
15-30%	2 (11.8)	0.110	0.021 to 0.564	<0.005
>30%	17 (65.4)	18,889	3,581 to 99,642	<0.005

The presence of plasma leakage can be observed by the presence of pleural effusion, hemoconcentration, and hypoalbuminemia. In some studies, significant pleural effusion has been associated with shock and mortality.[15]

In our study, DSS patients had varying PEI measurements: PEI <6 % (2.1%), PEI 6-15% (8.3%), PEI 15-30% (35.4%), and PEI >30% (54.2%). In a Thai study in DSS patients, pleural effusion was found in 22 of 26 DSS cases with an average of PEI of 4.1%.[16] The average PEI from our hospital in 2004 was 18.29% (DSS) and 4.75% (non-DSS).[15]

A limitation of our study was that we could not use a Kappa test for radiologists' assessment of x-ray findings, since this was a retrospective study.

Our study revealed a significant relationship between mortality rate from DSS and PEI. In conclusion, PEI >15% was a risk factor for mortality in children with DSS.

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