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Original Article

Downes score as a clinical assessment for hypoxemia in neonates with respiratory distress

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Abstract

Background Hypoxemia in neonates with clinical respiratory distress has a high mortality. Downes score is used as an alternative to evaluate clinical respiratory distress if blood gas analysis instrument or pulse oxymetry is not available.

Objective To evaluate the validity of Downes score for assessing hypoxemia in neonates with clinical respiratory distress.

Methods A cross sectional study was carried out on neonates with clinical respiratory distress hospitalized at level 2 and 3 Neonatal Care Unit and in Emergency Room of Dr. Sardjito General Hospital, Yogyakarta. Downes score and oxygen saturation measured by a pulse oximetry were compared. Hypoxemia was defined as oxygen saturation less than 90% in term and post-term infants, less than 88% in preterm neonates, or Downes score ≥5 according to Basic Emergency Service Training for Obstetry and Neonatology (PONED) in 2007. The accuracy of Downes score in predicting hypoxemia was assessed by sensitivity, specificity, positive-predictive value, negative-predictive value, and likelihood ratio.

Results Eighty nine neonates were evaluated. Downes score had sensitivity of 88%, specificity of 81%, positive-predictive value of 72%, negative- predictive value of 92%, positive likelihood ratio 4.53, negative likelihood ratio 0.15, prevalence of 36%, and post test probability of 72%.

Conclusion Downes score can be used as a clinical diagnostic means for assessing hypoxemia in clinical respiratory distressed neonates with 88% sensitivity (95% CI 79 to 99), and specificity 81% sensitivity (95% CI 70 to 91). **[Paediatr Indones. 2008;48:342-5]**.

Keywords: *Downes score, neonates, hypoxemia, respiratory distress*

Approximately 30-40% of neonatal cases requiring hospitalization suffer from respiratory distress with high morbidity and mortality rates.[1] Duke *et al* [2] in Papua New Guinea find that 53% of hypoxemia occurs in neonates with acute lower respiratory infection (ALRI) and in those without ALRI. Neonates with hypoxemia have 3.1 times higher mortality rate. Onyango[3] in Kenya observed 256 babies and children below three years with ALRI and found that 50% of them suffered from hypoxemia had a mortality rate of 4.3 times higher depends on the degree of hypoxemia.

Working diagnosis must be established in the first few minutes, and an early phase care must be conducted by giving oxygen. Therefore, it is necessary to conduct continuous monitoring and evaluation. The majority of conditions that cause respiratory distress can be avoided through early detection and control.[1]

The degree of hypoxemia should be measured with blood gas analysis (BGA). However, BGA in neonates can create complications due to pain, damage to the artery, increased risk of infection, thrombosis,

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and bleeding. For clinical purposes, the evaluation of hypoxemia can be conducted by using pulse oxymetry. A significant correlation of r=0.9 is achieved through a comparison of BGA saturation and pulse oxymetry in babies.[4] Hay[5] found a correlation of r=0.99 in premature and full-term babies. Another study finds a sensitivity of 92% and a specificity of 90%.[6] However, there is limitation of pulse oxymetry due to the high price of this instrument . Therefore, a clinical evaluation to determine the presence of hypoxemia at early stage without supporting tools is very important.[7,8,9]

In the Principles of Basic Neonatal Care Training Course,[10] a Downes score was used as a basis for clinically evaluating respiratory problems. A modified Downes score was used in Basic Emergency Service Training for Obstetry and Neonatology (PONED)[11] in 2007. Downes[12] stated that if Downes score is evaluated intensively every 30-60 minutes, it would be very useful for evaluating the progress of respiratory distress. Various sources, however, show different interpretations. Downes score by USAID Indonesia stated that a score of <4 means no of respiratory distress, 4-7 shows the presence of respiratory distress, while >7 shows the threat of respiratory failure. The absence or presence of cyanosis is determined by the minimum 40% oxygen, similar to that found by Downes. According to the Russian Federation-United States of America[13] and PONED, mild respiratory distress occurs if the score is ≤ 3, moderate respiratory distress if it is 4-5, and severe respiratory distress if the score is ≥ 6. In cyanosis evaluation by PONED in 2007, giving oxygen or not and determining whether the cyanosis persists or disappears is conducted instead of giving minimum 40% oxygen.

The aim of this study was to determine the validity of Downes score for assessing hyperoxaemia in neonates with respiratory distress.

Methods

We performed a diagnostic test study to compare Downes score to oxygen saturation measured by pulse oxymetry. This study was conducted in the levels 2 and 3 neonatal care unit and the emergency unit of the Dr. Sardjito Hospital. The inclusion criteria were neonates with signs of respiratory distress and an approval from parents. The exclusion criteria were fever, shock, severe anemia, abnormal central nerve system, polycytemia, and subjects who were not using the breathing support equipment. This research had been approved by the Medical Research Ethics Committee and the Medical School of Gadjah Mada University.

All subjects were evaluated using the pulse oxymetry and modified Downes score by PONED at the same time. The subjects were grouped into those with hypoxemia and those without hypoxemia based on both systems. Hypoxemia was considered present if SpO2 was <90% in full term neonates (≥37 week gestational age), and <88% in preterm babies. Based on Downes score,[12] the presence of hypoxemia was valued if the score was ≥ 5.

The sample size was calculated based on 95% confidence interval, absolute accuracy 0.1 and sensitivity of 80%. Subjects were recruited consecutively to a neonate was identified as suffering respiratory distress if he/she possessed one or more signs of nasal flare, retraction, tachypnea, grunting, or cyanosis. Cyanosis was evaluated by observing the bluishness of the lips, tongue and mouth mucosa under sufficient lighting. Mild retraction was defined as there was subcostal retraction and it was still apparent when the child made a movement. Severe retraction was defined as there were intercostal retraction, suprasternal or paradox breathing (see-saw). Grunting was observed and listened at the end of expiration. Breathing sound was listened from the top medial chest on the axillary line, to evaluate air-flow into the lung.

Oxygen saturation was measured using the Nellcor® pulse oxymetry by placing it on the left or right foot for 30 seconds, and the value on the monitor did not change for a minimum of 10 seconds. Severe anemia was diagnosed as hemoglobin level < 7 g/dL and polycytemia when vein haematocrit level was >65%. We considered fever when the axillar temperature was >37.5°C measured by a digital thermometer for one minute.

Results

There were 89 neonates recruited from October 2nd, 2007 to December 4th, 2007. The examiners' agreement test showed a Kappa value of 0.65 indicating a good agreement rate.

The characteristics of study subjects are shown in **Table 1.**

In this study, the hypoxemia limit from Downes score was identified by determining the cut off point in Receiver Operator Curve (ROC) at Downes score of 5. **Table 2** shows predictions of hypoxemia using comparative cut off point from Downes score.

Table 1. Characteristics of research subjects

Characteristics	Total
1. Gender (%):	
Male	30 (54)
Female	26 (46)
2. Weight at birth (%):	
< 2500 g	25 (45)
≥ 2500 g	31 (55)
3. Gestational age (%):	
< 37 weeks	21 (38)
≥ 37 weeks	35 (62)
4. Method of delivery (%):	
Spontaneous	38 (68)
Cesarean	18 (32)
5. Heart rate per min., mean (SD)	140 (13.7)
6. Temperature, 0C, mean (SD)	36.7 (0.51)
7. Hemoglobin, g/dL, mean (SD)	17.1 (2.25)
8. Age , yrs, mean (SD)	6.2 (6.03)

Table 2. Diagnostic means of hypoxemia using cut-off point from Downes score.

Downes Score	Sensitivity	95% CI	Specificity	95% CI
2	97	91 to 100	28	16 to 40
3	97	91 to 100	53	40 to 66
4	97	91 to 100	65	53 to 77
5	88	79 to 99	81	70 to 91
6	44	27 to 61	98	95 to 100
7	31	15 to 47	98	95 to 100
8	9	(-1) to 19	98	95 to 100
9	3	(-1) to 9	98	95 to 100

Downes score could detect 88% hypoxemia in neonates with respiratory distress (**Table 3**).

The results of diagnostic test based on Downes score parameters are shown in **Table 4**.

Table 3. Prediction of hypoxemia in neonates by using Downes score

	Value	95% CI
Sensitivity (%)	88	79 to 99
Specificity (%)	81	70 to 91
Positive Predictive Value (%)	72	58 to 86
Negative Predictive Value (%)	92	84 to 100
Positive Likelihood Ratio	4.53	2.62 to 7.83
Negative Likelihood Ratio	0.15	0.06 to 0.39
Pretest probability (%)	36	26 to 46

Discussion

Lack of control in evaluating neonates with respiratory distress can lead to late detection of hypoxemia. Based on the study conducted by Downes[12] a linear correlation was found between Downes score and PaO_2. Hypoxemia occurred in 50 mmHg PaO_2 and Downes score of 5. In this study, the cut off point for hypoxemia in ROC was at Downes score of 5, which was consistent with that found by the Downes original research.

The results of this study showed a sensitivity (Sn) 88% and specificity (Sp) 81%. The combination of several parallel clinical parameters showed that it could increase sensitivity with good specificity. Therefore, Downes score can be used to evaluate hypoxemia accurately in neonates with respiratory

Table 4. The results of diagnostic test based on Downes score parameter

Parameter	Sn (%)	Sp (%)	PPV (%)	NPV (%)	PLR (%)	NLR (%)	Post Test Probability
Respiratory rate	94	9	37	71	1.03	0,71	37
(95% CI)	(85 to 100)	(1 to 16)	(26 to 47)	(38 to 100)	(0.91 to 0.16)	(0.15 to 3.46)	
Cyanosis	56	82	64	77	3.21	0.53	64
(95% CI)	(39 to 73)	(73 to 92)	(47 to 82)	(66 to 88)	(1.69 to 6.08)	(0.35 to 0.80)	
Retraction	97	35	36	46	1.49	0.09	46
(95% CI)	(91 to 100)	(23 to 47)	(26 to 46)	(34 to 57)	(1.22 to 1.82)	(0.09 to 0.63)	
Grunting	38	95	80	73	7.13	0.66	80
(95% CI)	(21 to 54)	(89 to 100)	(60 to 100)	(63 to 83)	(2.17 to 23.39)	(0.50 to 0.87)	
Respiratory sound	88	63	57	90	2.38	0.20	57
(95% CI)	(76 to 99)	(51 to 76)	(43 to 71)	(81 to 99)	(1.65 to 3.42)	(0.08 to 0.51)	

distress and increase the probability of diagnosing hypoxemia 4.5 times compared to neonates without hypoxemia.

Evaluation of single clinical signs of neonatal hypoxemia tends to provide different results. Duke *et al*[2] found that cyanosis had good sensitivity and specivicity. Retraction and grunting showed low sensitivity, while cyanosis and grunting showed high specivicity. The study conducted by Onyango *et al*[3] on babies ≤2 months with ALRI showed that tachypnea and retraction correlated with high sensitivity, grunting with low sensitivity and specificity, and cyanosis with high specificity. In this study, an analysis on each Downes score parameter showed that tachypnea (respiratory rate >60x/ minute), retraction and respiratory sound possessed high sensitivity, with low specificity. Cyanosis and grunting resulted in low sensitivity with high specificity.

This study showed that a scoring system which requires only basic skills and minimum training for evaluating clinical signs can be used to assess hypoxemia, and therefore can also be used as a basis for giving oxygen or referrals.

The limitation of this study was that it was not blinded, since it will not be ethical if the examiners do not assess clinical and pulse oxymetry in respiratory distress patients. The size of the sample was not based on the prevalence of hypoxemia in Indonesia. The result of prevalence in this research was estimated at 36%, whereas the prevalence of hypoxemia in neonates based on the study conducted by Duke[2] used as sample size calculation for this research was 53%. Thus our sample did not totally represent the population of Indonesia. This was proven by the wide confidence interval. It was conducted in a tertiary health care centre, and may therefore lead to a referral bias.

In conclusion, Downes score can be used as a clinical diagnostic means for assessing hypoxemia in neonates with respiratory distress, with 88% sensitivity and 81%specificity

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