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Original Article

Effect of subdural hemorrhage on term infants development - a prospective study

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Abstract

Background Subdural haemorrhage (SDH) is a common problem in infants under 6 months of age and it has a risk to develop into developmental delay.

Objective To evaluate adverse effects of SDH on the development of term infants.

Methods It was a prospective cohort study carried out on infants below six months of age admitted to Sanglah Hospital due to SDH. Control was healthy term infants born in Sanglah Hospital. Mullen Scales test was performed at the age of 6 and 12 months. Multivariate analysis was conducted to examine the relationship between several independent variabels and developmental outcome.

Results Sixty six infants were enrolled in this study (33 infants with SDH and 33 infants without SDH), 52 (79%) were male and 14 (21%) were female. Mean age was 1.53 (SD 0.75) months vs 1.70 (SD 0.73) months. The result of Mullen Scales test at the age of 6 and 12 months showed that very low category was higher in infants with the history of SDH than that in control group. Multivariate logistic regression analysis showed that only SDH correlated with Gross Motor and Cognitive Scale delay at the age of 6 months and 12 months (Gross motor 6 months: P=0.01; OR 13.07; 95%CI 2.04;83.84; Gross motor 12 months: P=0.00; OR 23.58; 95%CI 2.87;193.84); (Cognitive 6 months: P=0.00; OR 12.11; 95%CI 2.44;59.90; Cognitive 12 months: P=0.00; OR 26.67; 95%CI 3.25;218.86).

Conclusion Term infants with history of subdural haemorrhage are associated with increased Gross Motor and Cognitive Scale delay at the age of 6 and 12 months.**[Paediatr Indones 2007;47:156-160]**.

Keywords*: term infants, subdural haemorrhage (SDH), Gross Motor Scale delay, Cognitive Scale delay, Mullen Scale test*

Subdural haemorrhages (SDH) is a collection of blood between duramater and arachnoid due to tearing of bridging cortical veins.[1-3] The diagnosis of SDH in infants and young children presents a big challenge for doctors, social workers, and courts because it is often difficult to determine whether SDH is caused by an accident or child abuse.[4] SDH in infants is well described both clinically and pathologically, but there are only few epidemiological data on this condition associated with death and disability.

The incidence of SDH in children under one year of age was 21/100,000 children/year.[4] The mortality of SDH in infants is 5%, but only 25% of them have normal development.[2] Therefore, term infants with the history of SDH need to be periodically followed up for their physical growth and mental development. Early detection and intervention should be done to optimalize developmental outcome. We conduct this study to investigate the effect of SDH on the development of term infants at the age of 6 and 12 months.

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Methods

This study was a three year cohort prospective study carried out on all infants under the age of 6 months with subdural haemorrhage (SDH) in Child Health Department, Medical Faculty of Udayana University/ Sanglah Hospital, Denpasar from January 2003 to April 2005.

Subjects were selected by consecutive sampling from all infants with SDH diagnosed by clinical examination and then confirmed by computed tomography (CT scan) until minimal number of subjects (33, with $P<0.05$; power 80%) was completed. Control group consisted of 33 healthy term infants without SDH, born in the same period at Sanglah Hospital and matched for sex and kind of labor. We excluded infants who had one or more following conditions: low birth weight, asphyxia, sepsis, meningitis, hypoglicemia, congenital anomaly, intracerebral bleeding, hyperbilirubinemia, cholestasis, HIE, and if they refused to participate. During follow up, they would be dropped out from the study if they had the following conditions: sepsis or meningitis, hypoglycemia, cholestasis, epilepsy, malnutrition, moving out, and refused to continue the participation. The study had been approved by the Ethics Committee of Medical Faculty of Udayana University/ Sanglah Hospital, Denpasar.

The developmental outcome of all infants were assessed at the age of 6 and 12 months using Mullen Scales of Early Learning, American Guidance Service (AGS) edition.[5,6] Mullen Scales test is designed for newborn infants through 68 months of age. This scales provide normative scores for five specific scales: Gross Motor, Visual Reception, Fine Motor, Receptive Language and a single composite score representing general intelligence.

After scoring all items in each developmental sector, we computed raw score to obtain T score, percentile ranks, descriptive categories and age equivalens. Finally we found Early Learning Composite score. By using this score, we categorized developmental score into five categories: Very High, Above Average, Average, Below Average and Very Low. The infants categorized as delay development if the descriptive categories fell in Below Average and Very Low.[6]

The statistical analysis was performed using SPSS for Windows, ver. 11.5. Comparison between the study groups for discrete variables was using Chi-square test, and for numerical variables used unpaired t-test. Relative Risk (RR) was calculated to determine association between dependent variable (SDH) and independent variable (developmental category). Multivariate logistic regression analysis was used to evaluate the relationship between several independent and dependent variables. A P value <0.05 was considered to be statistically significant.

Results

During the study, there were 38 term infants with subdural hemorrhage (SDH). Four of them were excluded because they presented with signs or symptoms of cholestasis, low birth weight, and intracerebral haemorrhage. One of them was dropped out due to moving out or loss to follow up. As a result, a total of 66 subjects (infants with SDH and control) were enrolled in the study.

Tabel 1. Demographic characteristics of term infants with and without SDH

Variable	SDH (+) (n=33)	SDH (-) (n=33)
Age(mo)		
Mean (SD)	.53 (0.75)	1.70 (0.73)
Birthweight(g)		
Mean (SD)	3095.45 (336.43)	3198.48 (351.45)
Gestational age(wk)		
Mean (SD)	37.94 (0.79)	37.76 (1.69)
Delivery, n(%)		
Operative	1 (3)	1 (3)
Normal	32 (97)	32 (97)
Sex, n(%)		
Boys	26 (79)	26 (79)
Girls	7 (21)	7 (21)
Vitamin K oral/injection	4 (11)	33 (100)
Nutrition intake, n(%)		
Breastfeeding	29 (88)	19 (58)
Breastfeeding +formula	4 (12)	14 (42)
Stimulation n(%)		
Good	27 (82)	29 (88)
Poor	6 (18)	4 (12)
Mother's age(yr),		
Mean (SD)	28.91 (4)	29.42 (2)
Mother's education, n(%)		
Secondary school	13 (39)	2 (6)
High school	20 (61)	30 (91)
University	0	1 (3)
Mother's occupation, n(%)		
Housewife	31 (94)	15 (46)
Government empl.	0	15 (46)
Private employee	2 (6)	3 (9)

Of 33 term infants with SDH, all of them presented with a sign of tense fontanel, 94% had convulsion, 52% were apathetic, 15% were somnolent, and 33% were in comatous condition. The mean level of hemoglobin was 5.62 (SD 1.93) g/dL. All infants with SDH were examined using CT scan and they mostly showed bilateral lesions in frontoparietal region.The demography characteristics of the subjects showed in **Table 1**.

At 6 and 12 months, the developmental outcome was evaluated using Mullen Scale test. Very Low category was found to be higher in infants with the history of SDH compared to that in group without SDH. This was statistically significant for all categories **(Tables 2 and 3).**

Multivariate logistic regression analysis showed that only SDH group correlated with Gross Motor Scale at the age of 6 mo (P=0.01; OR 13.07; 95%CI 2.04;83.84) and 12 mo (P=0.00; OR 23.58; 95%CI 2.87;193.84) **(Table 4).**

Cognitive Scale in the Mullen Scale test is a cumulative scale between Fine Motor, Visual Reception, Receptive Language, and Expressive Language Scale. After having been analysed using multivariate logistic regression analysis, only SDH was correlated with cognitive delay at the age of 6 months (P=0.00; OR 12.11; 95%CI 2.44;59.90); at the age of 12 months, the results of cognitive delay were similar (P=0.00; OR 26.67; 95%CI 3.25;218.86) **(Table 5).**

Discussion

There are many instruments to determine a child's development, such as Bayley Infant Scale of Development-Second Edition (BSID-II), Vineland, and Mullen Scales of Early Learning (MSEL).[5,7] In this study, we used Mullen Scales of Early Learning because it is easy to use and has better validity compared to other tests.[6]

Subdural haemorrhage (SDH) in infants often occurs under 6 months of age and data showed that 95% of these are caused by nonaccidental trauma. This is due to unique features of infant's brain. The infant's head is heavy but supported by weak neck

Tabel 2. Descriptive categories of developmental outcome in term infants using Mullen Scale test at 6 months of age

Descriptive categories	SDH (+) N=33	SDH (-) N=33	P	RR (95%CI)
Gross motor, n				
Very low	11 (33)	0	0.00	8.33 (2.12-32.80)*
Below average	4 (12)	3 (9)		
Average	18 (55)	30 (91)		
Fine motor, n				
Very low	11 (33)	0	0.00	12.92 (2.65-63.06)*
Below average	4 (12)	2 (6)		
Average	18 (55)	31 (94)		
Visual reception, n				
Very low	11 (33)	0	0.00	11.42 (2.33-55.86)*
Below average	3 (9)	2 (6)		
Average	19 (58)	31 (94)		
Receptive language, n				
Very low	12 (36)	0	0.00	10.63 (2.70-41.78)*
Below average	5 (15)	3 (9)		
Average	16 (49)	30 (91)		
Expressive language, n				
Very low	12 (36)	1 (3)	0.01	4.46 (1.51-13.12)*
Below average	6 (18)	6 (18)		
Average	15 (46)	26 (79)		
Cognitive, n				
Very low	11 (33)	0	0.00	8.33 (2.11-32.81)*
Below average	4 (12)	3 (9)		
Average	18 (55)	30 (91)		

CI: Confidence interval; P: probability
CI and P value average compares with Below average + Very low

Tabel 3. Descriptive categories of developmental outcome in term infants using Mullen Scale test at 12 months of age

Descriptive categories	SDH (+) n (33)	SDH (-) n (33)	P	RR (95%CI)
Gross motor, n(%)				
Very low	11 (33)	0	0.00	23.58 (2.87-193.84)*
Below average	3 (9)	1 (3)		
Average	19 (58)	32 (97)		
Fine motor, n(%)				
Very low	11 (33)	0	0.00	23.58 (2.87-193.84)*
Below average	3 (9)	1 (3)		
Average	19 (58)	32 (97)		
Visual reception, n(%)				
Very low	11 (33)	0	0.00	11.42 (2.33-55.89)*
Below average	3 (9)	2 (6)		
Average	19 (58)	31 (94)		
Receptive language, n(%)				
Very low	11 (33.3)	0	0.00	26.67 (3.25-218.86)*
Below average	4 (12.1)	1 (3)		
Average	18 (54.50)	32 (97)		
Ekspressive language, n(%)				
Very low	12 (36)	1 (3)	0.00	7.70 (2.21-26.85)*
Below average	5 (15)	3 (9)		
Average	16 (49)	29 (88)		
Cognitive, n(%)				
Very low	11 (33)	0	0.00	26.67 (3.25-218.86)*
Below average	4 (12)	1 (3)		
Average	18 (55)	32 (97)		

CI: Confidence interval; P: probability

* CI and P value average compares with Below average + Very low

Tabel 4. Relationship between some independent variables with Gross Motor Scale delay at 12 months of age

Variables	P	OR	95% CI
SDH	0.00	23.58	2.87;193.84
Age of infants	0.64	0.78	0.28;2.19
Mother's education	0.42	1.89	0.41;8.72
Mother's employee	0.59	1.80	0.21;15.24
Nutritional intake	0.10	6.86	0.68;69.48

CI: Confidence Interval; P: probability; OR: Odds Ratio

Tabel 5. Relationship between some independent variables with Cognitive Scale delay at 12 months of age

Variables	P	OR	95%CI
SDH	0.00	26.67	3.25;218.86
Age of infants	0.53	1.35	0.54;3.35
Mother's education	0.55	1.58	0.35;7.07
Mother's employee	0.64	1.68	0.19;14.93
Nutritional intake	0.14	5.65	0.57;55.69

CI: Confidence Interval; p: probability; OR: Odds Ratio

muscles, and the brain is soft, suspended in a large CSF space, allowing excessive forces at the attachment of the bridging cerebral veins. Rotational forces like in whiplash injuries may result in intracranial bleeding.[4,8,9]

The age range and male predominant also confirm the findings of other study.[6,10] It has been postulated that many parents believe that boys are more tough than girls.[6]

Clinical presentation of SDH appears as a result of blood collection forming a mass that presses the brain tissue. This pressure damages the brain tissue and causes loss of brain function, which later may progressively worsen as the mass become enlarged and the intracranial pressure increases. The injury and the resulting blood collection cause an inflamation to the brain tissues, which leads to brain swelling (cerebral edema). This swelling further increases the pressure.[11,12] This may result in clinical presentation as changing behavior, irritability, loss of consciousness, high-piched cry, vomiting, convulsions, pale or bluish skin (cyanosis). Parent[10] showed that the clinical manifestations can be asymptomatic, anorexic, lethargy, coma, apnea and convulsion in 30% of the 43 infants with SDH. Tzioumi and Oates[9] showed that of 21 infants with SDH due to non-accidental injury, there were 52% infants with convulsion, 28% with vomiting, 14% with irritability, 14% with drowsiness, and 24% with loss of conciousness.

The outcome of SDH depends on the location and the spreading of the bleeding. Blood collected as a mass, which presses the brain tissues (cerebral cortex). Cerebral cortex, a Broadmann area, has functions as motoric, premotoric, optokinetic, brocca and somatosensoric area. Any damage in this area cause disability of motoric function, somatosensory, brocca, and somatosensoric area.[13,14]

Our study showed very low gross motor and fine motor test in infants with SDH because of the location of the hemorrhage was mostly in frontoparietal area. Golden[15] in 2 year study about the outcome of infants with SDH found severe disability in 45.5% and moderate disability in 23.3%. Jayawant *et al*[4] found severe disability in 45.5%, moderate disability in 27.3% of 33 infants with SDH.

Study regarding an outcome of cognitive development in infants with SDH is limited. Ewing *et al*[16] found that using Bayley Scales of Infant Development Mental and Motor Scales-Second Edition, of the 20 infants with Inflicted Traumatic Brain Injury, 45% of them showed mental deficiency. In our study, cognitive development of 45% infants with SDH were below average and very low, and this occurred 8 times more frequent at 6 months of age and 26 times more frequent at 12 months of age than that in infants without SDH.

Transient neurological deficits are associated with ischemic related to impaired cerebral blood flow in chronic SDH infants. It is unclear whether simple compression or vessel distortion that causes this changes.[10] In addition, permanent neurological deficit and delay development are as a result to blood accumulated in the floor of middle and posterior cranial fossae and also due to blood accumulation caused by parenchymal brain injury. These abnormalities can be identified by MRI. This study had a limitation limitation that the diagnosis of SDH was not confirmed by MRI, only using CT scan.

In conclusion, term infants with a history of SDH are associated with increased Gross Motor and Cognitive delay at the age of 6 months and 12 months.

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