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Original Article

Neonatal birth trauma: incidence and predisposing factors

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ABSTRACT

Background The incidence of birth trauma and its predisposing factors at a major teaching hospital in Indonesia had not been reported.

Objective To find the incidence of birth trauma, calculate a risk assessment of predisposing factors, to study whether cesarean section lowers birth trauma, and to identify the variety of morbidity and mortality due to birth trauma.

Methods The incidence was studied retrospectively from 4843 medical records from January 2000 through June 2001 using the ICD-10 classification. Birth trauma cases were then included in a case-control study for a risk assessment profile of predisposing factors with logistic regression analysis.

Results Three hundreds and thirty five out of 4843 neonates were identified to have birth trauma. Analysis revealed that forceps extraction (OR=48.29; p<0.01), vacuum extraction (OR=25.37; p<0.01), breech vaginal delivery (OR=3.94; p=0.03), and cesarean section (OR=3.44; p<0.01) were significant risk factors. Macrosomic infant (OR=3.86; p=0.04) was also significant. Birth injury to face (ICD-10 code P15.4) was the most common finding, followed by cephalhematoma and bruising of the scalp. There was no mortality due to birth trauma.

Conclusions The incidence of birth trauma was still high. Cesarean section was found to be one of the risk factors, but compared to forceps and vacuum extraction, the risk of trauma is considered to be more acceptable **[Paediatr Indones 2003;43:220-225].**

Keywords: birth trauma, cesarean section, forceps extraction, vacuum extraction

Birth trauma is one of the contributing factors of neonatal mortality besides asphyxia, prematurity, and neonatal infections and considered to be one of the clinical indicators in obstetric care.[1] Birth trauma is any condition that affects the fetus adversely during delivery.[2] It does not include any injury due to amniocentesis, venous puncture and active resuscitation.[3] The traumatic events can be divided into those caused by mechanical forces and those by hypoxia and this study is limited to mechanical birth trauma. Factors predisposing the infant to birth trauma include parity, macrosomia (birth weight ≥4000g), prematurity, cephalopelvic disproportion (CPD), prolonged labor, abnormal presentation, and mode of delivery.[3-6]

Rubin reported 7.2 cases per 1000 live-births in 1964.[7] During the ensuing decade, refinement in obstetric techniques resulted in a steady decline of birth trauma as a cause of neonatal death,[4, 8-10] but still represents an important cause of neonatal morbidity. However some controversies arise regarding the increasing application of cesarean delivery reaching the rate of 25% of all deliveries.[4, 11] The purpose of the study was to define the incidence of neonatal birth trauma, make a risk assessment profile of several predisposing factors, study whether cesarean section can lower birth trauma, and identify the variety of morbidity and mortality due to birth trauma.

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Methods

We reviewed data of neonates born between January 1, 2000 and June 30, 2001 in a survey on incidence of birth trauma at the delivery room, Cipto Mangunkusumo General Hospital Jakarta, Indonesia. All mechanical birth trauma were coded using the International Classification of Disease-10 (ICD-10). Neonates with birth trauma and controls were taken randomly from the same population and then recruited into a case-control study with case-control ratio of 1:1. Controls were recruited randomly from the same population each month in accordance with the rotation of doctor in-charge in the delivery room. This method was applied to minimize human factor as one of the possible risk factor of birth trauma. All available data were reviewed, including maternal age, parity, gestational age, presentation, the existence of CPD, mode of delivery, APGAR score, length of labor, birth weight, and diagnosis of associated injuries. Data were processed into a computerized database using SPSS ver.10.0 and were statistically reviewed.

Variables of parity, presentation, gestational age, CPD, length of labor, macrosomia, and mode of delivery were analyzed both by bivariate and multivariate analysis. One-tailed chi-square test was applied in the bivariate analysis. Backward stepwise-wald method was applied in the multivariate analysis. P values of <0.05, odds ratios ≥ 2.5 with 95% confidence intervals were considered statistically significant.

Results

Three hundreds and thirty five out of 4843 neonates born during the study period were identified to have birth trauma, meaning an incidence of 69.2 cases per 1000 live births. All neonates were then included in a case-control study, and a total of 670 subjects were reviewed both by bivariate and multivariate analysis.

Table 1 depicts the results of bivariate analysis of each independent variable. Variables that correlated significantly with birth trauma in bivariate analysis and variables that had solid evidence in the previous reports were processed further in the logistic model.

TABLE 1. BIVARIATE ANALYSIS OF EACH PREDISPOSING FACTOR OF BIRTH TRAUMA

Risk factors		Case (N=335)	Control (N=335)	Bivariate analysis
Parity	Nulliparous	185	148	OR=1.56 (1.15;2.11); p=0.003
	Multiparous[R]	150	187	
Gestational age	Full-term[R]	292	290	
	Pre-term	29	33	OR=0.88 (0.52;1.47); p=0.61
	Post-term	14	12	OR=1.16 (0.53;2.55); p=0.72
Presentation	Cephalic[R]	302	279	
	Face	9	0	OR=9.24 (1.18;72.64); p=0.01
	Breech	14	34	OR=0.38 (0.20;0.72); p<0.01
	Foot	4	8	OR=0.46 (0.14;1.55); p=0.2
	Transverse-lie	4	14	OR=0.26 (0.09;0.81); p=0.01
	Multiple	2	0	OR=1.85 (0.34;10.17); p=0.47
Birth weight	Macrosomia	14	6	OR=2.39 (0.91;6.30); p=0.55
	No [R]	321	329	
CPD	Yes	18	23	OR=0.77(0.41;1.46); p=0.26
	No[R]	317	312	
Mode of delivery	Spontaneus Vaginal Delivery[R]	27	168	
	Breech	5	8	OR=3.89 (1.18;12.77); p=0.017
	Forceps	166	20	OR=51.64 (27.64;95.69); p<0.01
	Vacuum	55	13	OR=26.32 (12.71;54.59); p<0.01
	Cesarean	82	126	OR=4.04 (2.47;6.63); p<0.01
Length of labor	≥14,5 h	82	39	OR=2.66 (1.73;4.07); p<0.01
	<14,5 h[R]	190	240	

[R] = reference point which is OR=1

There were 333 deliveries by nulliparous women, 245 of which were delivered with forceps, vacuum extraction, or cesarean section, resulting in 185 birth trauma cases. Infants born to nulliparous women tend to be delivered operatively 1.54 times more often than multiparous women (1.11-2.14; p<0.01). They tend to have birth trauma 1.56 times more often than multiparous women (1.15-2.11; p<0.01).

Gestational age was not a significant risk factor of birth trauma. Compared to full-term infants, the odds ratio was 0.88 (0.52;1.47; p=0.61).

Using cephalic presentation as reference point, face presentation was apparently the only presentation that correlates significantly with birth trauma (OR=9.24; 1.18;72.64; p= 0.01). On the other hand, breech presentation (OR=0.38; 0.20;0.72; p<0.01) and transverse-lie were found to have significant protective effect (OR=0.26; 0.09;0.81; p=0.01).

Only 20 out of 670 subjects were categorized as macrosomic infants. Fourteen of these infants were injured. By bivariate analysis this figure was not a significant risk (OR=2.39; 0.91;6.30; p=0.55). The existence of cephalopelvic disproportion was also not a significant risk of birth trauma (OR=0.77; 0.41;1.46; p=0.26) since all were delivered by cesarean section. We also found that all modes of delivery except spontaneous vaginal delivery were factors that correlated significantly with birth trauma.

Prolonged labor was defined as length of labor of ≥14.5 hours.[12] Out of the 670 studied neonates, 119 data concerning length of labor were missing which were due to cesarean section prior to labor; cesarean section on emergency cases; and accidental deliveries that happened before the mother arrived at the delivery room. Bivariate analysis resulted in the tendency of infants with history of prolonged labor to have birth trauma (OR= 2.6; CI 95%; p<0.01).

Previous reports never explicitly excluded parity, prematurity and macrosomia as risk factor of birth trauma. Those three variables, along with face presentation, modes of delivery and length of labor, were included in the logistic model.

Multivariate analysis showed a significant association of breech delivery, forceps & vacuum application, cesarean section, and macrosomia with the incidence of birth trauma (**Table 2**).

This study found 11 variants of trauma according to ICD-10 (**Figure 1**). Nine neonates died during the study. Sepsis, respiratory distress syndrome, and congenital anomalies were considered to be the cause of death. There was no proven evidence that birth trauma caused neonatal death since most of the traumas were considered to be insignificant. More than 50% of the traumas consisted of injuries to the soft tissue caused by forceps application and pressure of the presenting part on the passage. Birth injury to the face was the most frequent (45.7%). Cephalhematoma was found in 14/1000 live births, chignon and injury to eyes were in 5.7 and 2.9/ 1000 live births respectively. Erb's paralysis, facial nerve paralysis, injury to sternocleidomastoid, external

TABLE 2. BIVARIATE AND LOGISTIC REGRESSION ANALYSIS OF SEVERAL PREDISPOSING FACTORS OF BIRTH TRAUMA

	Bivariate analysis			Multivariate analysis		
Variable	**Odds ratio**	**p**		**Odds ratio**	**p**	
Parity	1.56	<0.01	NS	0.99	0.96	NS
Presentation						
Face Presentation	9.24	0.01	S	0.91	0.44	NS
Mode of delivery						
Breech delivery	3.89	0.02	S	3.94	0.03	S
Forceps	51.64	<0.01	S	48.29	<0.01	S
Vacuum	26.32	<0.01	S	25.37	<0.01	S
Cesarean section	4.05	<0.01	S	3.44	<0.01	S
Length of labor						
≥14.5 hours	2.67	<0.01	S	1.52	0.12	NS
Gestational age						
Prematurity	0.88	0.61	NS	0.80	0.47	NS
Macrosomia						
Yes	2.39	0.55	NS	3.86	0.04	S

S= significant; NS= no significant

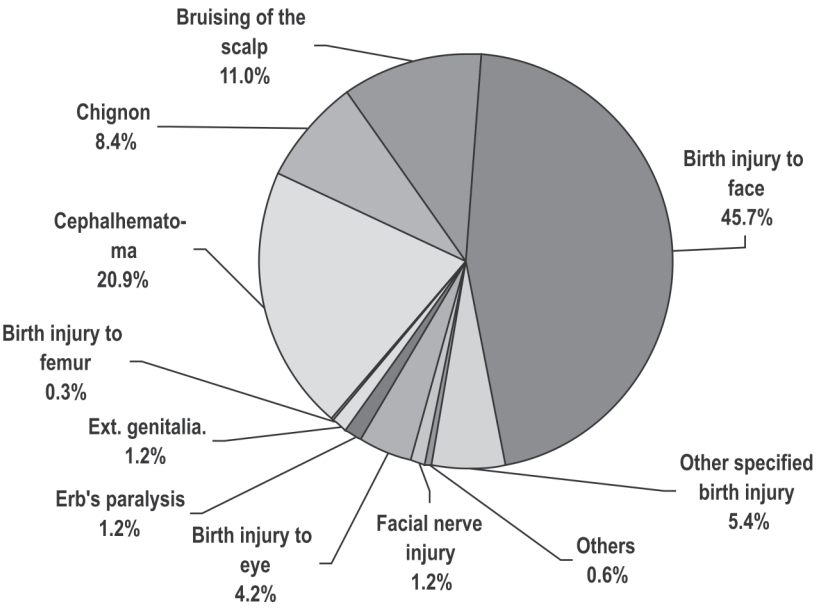

Figure 1. Variants of trauma

genitalia, and fracture of femur were less than 1/1000 live births (**Figure 1**).

Discussion

The choice of ICD-10 as the reference classification brought the consequence of higher incidence of birth trauma found in this study. Previous report by Rubin who studied only fractured clavicle, facial nerve injury, intracranial injury, fractured humerus, phrenic nerve injury, spinal cord injury, skull fracture, and laceration found the incidence of 7.2/1000 live births.[7] Reports from Hughes *et al* and Levine *et al* stated the incidence as 9.56 and 12.1 cases/1000 live births respectively.[13,14] Hughes only studied birth-associated trauma to the head and neck.[13] Levine *et al* used ICD code 761 as a reference but they excluded nonspecific birth injuries such as cephalhematoma.[14]

If minor birth injuries such as bruising and trauma to the face were excluded in this study, the incidence of birth trauma would be 29.94/1000 live births. Although making such a comparison was not proper, the incidence in this study was still considered to be high.

There was a tendency that babies of nulliparous women are delivered operatively which was similar to Towner *et al.*[6] This tendency might be the reason why parity was not associated with birth trauma in our study, in contrast with Hughes who found an association. This should be further studied. Gestational age was not associated with birth trauma. Although premature infants were not free from birth trauma, this phenomenon needs to be further studied since 50% of premature infants were delivered by cesarean section. Hughes and Levine did not study premature infants on their reports.

Face presentation was found to be the significant risk factor of birth trauma on bivariate analysis. On the other hand multivariate analysis showed this variable only as a confounding variable. Statistical review showed that malpresentation was the confounding factor of length of labor and macrosomia. When these two factors were included in the model, the odds ratio of malpresentation became not significant.

This study also found that breech presentation tends to have protective effect. This result was in accordance with Hughes and Levine who did not find breech presentation as a predisposing factor to birth trauma.[13,14]

Length of labor longer than 14.5 hours was a significant risk factor only on bivariate analysis and this was similar to statistical findings in the variable of presentation. The authors did not consider this to be the same as the variable of presentation since there were

so many missing values and the role of prolonged labor cannot be determined in this study.

Macrosomia was found to be a significant risk factor of birth trauma after it was included in the logistic model and excluding the confounders. Macrosomic infants increased the risk of trauma by 3.86 times compared to non-macrosomic infants, as were the reports from McFarland and Kolderup who found that macrosomic infants increased the risk of trauma by 2.5 and 6 times consecutively.[15, 16]

The existence of CPD was not a significant risk factor. Some reviews stated that CPD has an important role, but no original article supported this.[3, 5] Levine and Beall mentioned another predisposing factor of birth trauma, so called shoulder dystocia.[14, 17] As with CPD, shoulder dystocia also occurs as resultants of passenger (fetus), passage (birth canal) and power (uterine contractions). We did not study shoulder dystocia since it was not recorded.

The most important risk factor of birth trauma was the application of forceps and vacuum. These two modalities increased the risk of trauma by 48 and 25 times consecutively. This result was similar to previous studies.[6, 13, 14]

During this study, forceps were used more frequently than vacuum extraction. It is understandable that nearly 50% of birth traumas were injuries to the face due to misplaced forceps application. This was different from Hughes *et al* who found cephalhematomas in a larger proportion since in Hughes' study vacuum application was more frequent.

Failures of vacuum delivery were more frequent than forceps delivery. This was similar to Johansson who found 27% of failed vacuum compared to 10% of failed forceps.[18] All failed forceps, failed vacuum, and the sequential use of instruments at operative vaginal deliveries caused birth trauma.

Although breech-vaginal delivery was found to be a significant risk factor of birth trauma, we also found an equal proportion of birth trauma in cesarean section. This result is in accordance with the report of Croughan-Minihane *et al*.[19]

Special attention was put on the role of cesarean section in the occurrence of birth trauma. Both bivariate and multivariate analysis proved a significant role of cesarean section, with the risk increased 3 times. The result was similar to Towner *et al* who found odds ratio of 2.5. In a complicated labor, delivery by cesarean section can be an acceptable alternative. This study and previous studies by Hughes and Levine indicated that cesarean section does not guarantee an injury-free infant.

Compared to Notzon's study, this study also found a high rate of cesarean delivery. Notzon found 32% cesarean delivery rate in Brazil [20] We found cesarean delivery rate of 31% during the study.

No mortality was caused by birth trauma in this study. No proven evidence revealed the existence of intracranial injury. Limited bedside imaging modalities could be the cause of this lacking evidence.

We concluded that although the incidence of birth trauma in Cipto Mangunkusumo Hospital was considered to be high, significant variants such as fractured femur, facial nerve injury, Erb's paralysis and birth injury to eye were found only in small proportions. Macrosomia, breech vaginal delivery, forceps and vacuum application were factors that correlate significantly with birth trauma. Cesarean section was also found to be a significant risk factor. In complicated labor, cesarean section is a more acceptable method compared to other methods of delivery.

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