

Intracranial hemorrhage in full-term infants following vaginal delivery in a Japanese perinatal center

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Objective: This study was performed to characterize neonatal intracranial hemorrhage (ICH) in full-term vaginal delivery by mode of delivery (epidural analgesia or mechanical assistance such as vacuum extraction (V/E) or forceps delivery) in a Japanese perinatal center.

Methods: In a retrospective observational case series study, we examined 6,600 consecutive term singleton vertex vaginal deliveries. Cases with neonatal symptomatic ICH were extracted, and the clinical backgrounds, the delivery courses and the neonatal outcomes of these cases were analyzed.

Results: Maternal epidural analgesia significantly increased deliveries with mechanical assistance. ICH was identified in 8 cases (5 in deliveries with V/E and 3 in unassisted deliveries). The incidence of neonatal ICH was 0.24% in deliveries with V/E and 0.07% in unassisted deliveries.

Conclusion: The incidence of neonatal ICH in full-term deliveries in a certain Japanese perinatal center was similar to previous reports of such incidence in other countries.

Key words: intracranial hemorrhage, vacuum extraction, neurologic impairment

Introduction

Neonatal intracranial hemorrhage (ICH) is observed less frequently in full-term infants compared to preterm infants. However, the ICH in full-term infants has characteristics different from those in preterm infants. It has been suggested that the ICH in full-term infants is closely related to mechanical damage such as birth injury and perinatal hypoxic events, while in preterm infants they are associated with anatomical and functional immaturity in cerebral blood vessels.¹ Furthermore, the anatomical locations of hemorrhage are different between full-term and preterm infants; and subdural or subarachnoidal hemorrhage is more frequent in full-term infants.² Therefore, we focused on the clinical course of 8 cases of ICH among 6,600 term vaginal deliveries in Kitasato University Hospital as a representative Japanese perinatal center to elucidate clinical characteristics of ICH in full-term infants.

Materials and Methods

In this retrospective observational case series, we examined 6,600 consecutive term singleton vertex vaginal deliveries at Kitasato University Hospital between January 1, 1993 and June 30, 1999. One case with a clear fetal anomaly and a chromosomal abnormality was excluded. This study was approved by the institutional review board of Kitasato University School of Medicine.

Neonatal ICH was diagnosed based on postnatal clinical symptoms and findings by ultrasonography or a CT-scan. Clinical backgrounds, delivery courses and neonatal outcomes of these cases were also analyzed retrospectively. The incidence of neonatal ICH was compared between modes of delivery (vacuum extraction [V/E], forceps delivery, and spontaneous delivery without mechanical assistance) and with or without maternal epidural analgesia.

Statistical analyses were performed using a Sigmaplot 3.5 for Windows (Systat Software Inc., Point Richmond, CA, USA). Statistical significance was set at $P < 0.05$.

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Table 1. Patients' obstetrical backgrounds

Case No.	Maternal age (yr)	Para	Gestational age (w)	Obstetrical complications	Labor	Anesthesia
1	33	0	41	-	Induced	Epidural
2	40	0	38	-	Induced	Epidural
3	30	1	39	-	Induced	Epidural
4	26	0	39	-	Augmented	Epidural
5	26	1	38	-	Spontaneous	None
6	29	0	39	-	Induced	Epidural
7	34	0	38	-	Augmented	Epidural
8	24	1	37	PIH	Spontaneous	Epidural

PIH, pregnancy induced hypertension

Table 2. Course of delivery

Case No.	1st stage (min)	2nd stage (min)	Abnormal FHR pattern		Intrauterine resuscitation	Cord entanglement	Malrotation	Mode of delivery	Indication of VE
			1st stage	2nd stage					
1	871	1	VD	VD, LD	Oxygen	Neck	Deep transverse arrest	VE	NRFS
2	405	29	VD	VD	-	Neck	-	VE	NRFS
3	260	45	-	-	-	Foot	-	VE	
4	680	60	-	-	-	-	-	VE	
5	270	22	-	-	-	-	-	NSD	
6	175	71	-	-	-	-	-	NSD	
7	705	37	-	VD	Oxygen	Neck	-	VE	NRFS
8	325	13	-	VD, LD	Amnioinfusion	Neck	-	NSD	

FHR, fetal heart rate; VD, variable deceleration; LD, late deceleration; VE, vacuum extraction; NSD, normal spontaneous delivery; NRFS, nonreassuring fetal status

Table 3. Neonatal prognoses

Case No.	Birth weight (g)	Apgar score at 1 min/5 min	Umbilical artery pH	Initial clinical symptoms	Subarachnoid hemorrhage	Subdural hemorrhage	Treatment	Prognosis
1	3,749	9/10	7.29	Suckling impairment	+	-	-	Good
2	2,846	2/8	7.24	Tachypnea	+	-	-	Good
3	2,648	8/9	7.11	Scalp ablation, External bleeding	+	-	-	Good
4	3,380	7/9	7.31	Seizure	+	-	Hydrocephalus → V-P shunt	MR + CP
5	3,004	8/9	7.32	Apnea	+	-	-	Good
6	2,668	9/9	7.28	Apnea	+	-	-	Good
7	3,502	9/10	7.29	Apnea	+	+	Conservative	Good
8	1,608	5/8	7.09	Seizure	+	-	Hydrocephalus → Conservative	Good

SDH, subdural hemorrhage; V-P shunt, ventriculo-peritoneal shunting; MR, mental retardation; CP, cerebral palsy

Results

During the study period, 66% of vaginal deliveries were under maternal epidural analgesia. There were 4,278 vaginal deliveries without mechanical assistance, 2,074 vacuum deliveries, and 248 forceps deliveries. Of all deliveries with and without epidural analgesia, 45% and 17% cases required mechanical assistance, respectively. There was a significant difference in the rate of mechanical assistance between deliveries with and without maternal epidural analgesia ($P < 0.001$).

Clinical background

Eight infants were diagnosed as ICH. Maternal age was 30.3 ± 5.3 years (mean \pm SD) and gestational age was 38.6 ± 1.2 weeks. Five cases were of primigravidae. One mother was complicated with pregnancy induced hypertension. Epidural analgesia was used in 7 other mothers, and oxytocin was used for 6 mothers (Table 1). The first and second stages of labor in the mothers of the 8 ICH cases were 461 ± 255 minutes and 35 ± 24 minutes, respectively. Abnormal fetal heart rate pattern was observed in 4 cases, and in 3 of those, intrauterine resuscitation such as maternal oxygen administration and amniotic fluid infusion was performed. V/E was performed in 5 cases. In 3 cases, V/E was performed due to the diagnosis of nonreassuring fetal status, while elective V/E was performed in 2 cases (Table 2). The body weight of 8 neonates with ICH was $2,928 \pm 666$ g (Table 3). There were 2 heavy-for-date and 1 growth restricted infants. Apgar scores at 1 minute for 2 cases were less than 7 points, although Apgar scores at 5 minutes for all cases were above 7 points (Table 3). Umbilical arterial pH was less than 7.2 in 2 cases, but there were no cases of umbilical arterial pH less than 7.0 (Table 3).

Clinical features (Table 3)

Subarachnoid hemorrhage was observed in all 8 cases. One case was also complicated by subdural hemorrhage. It was confirmed that there was neither an underlying

disease nor a hemorrhagic diathesis in any of the cases. The initial symptoms in 3 cases were apnea. Other symptoms included poor suckling, tachypnea, scalp laceration, and seizure. In addition, 1 case was diagnosed as a small-for-date infant with ultrasonographic work-up. Hydrocephalus developed in 2 cases, in 1 case of which ventriculo-peritoneal shunting was required at the age of 2 months. This patient eventually developed neurological impairments (MR + CP). The other 7 cases have been recovered with conservative management.

Incidence of ICH by the mode of delivery

There were 3 ICH cases in 4,278 unassisted vaginal deliveries (0.07%) and 5 ICH cases in 2,074 V/E deliveries (0.24%) (Table 4). No ICH was observed in 248 forceps deliveries. The incidences of ICH infants whose mothers were with or without epidural analgesia were 0.15% and 0.05%, respectively. The incidences of ICH infants who were not statistically different by modes of delivery (χ^2 analysis, $P = 0.16$), and with or without maternal epidural analgesia (χ^2 analysis, $P = 0.537$).

Discussion

Although the actual incidence of ICH infants is generally low (0.12%-0.35%), deliveries with V/E significantly increase the incidence of ICH in term neonates compared to deliveries without mechanical assistance. The reported incidence of ICH infants with deliveries without mechanical assistance was 0.03%-0.06%.³⁻⁵ However, limited information is available on the incidences in Japan. Furthermore, effects of maternal epidural analgesia during labor on the incidence of neonatal ICH are still not available.

In the present study, the incidence of neonatal ICH with and without mechanical assistance was 0.22% (0.24% in V/E and 0% in forceps delivery) and 0.07%, respectively. These values are similar to the values in previous reports.³⁻⁵ It is likely that the potential risk of neonatal ICH with V/E in Japan is not different from that

Table 4. Frequency of intracranial hemorrhage

	No. of deliveries	Intracranial hemorrhage	Incidence	95% CI
NSD	4,278	3	0.07%	0.02%-0.21%
VE	2,074	5	0.24%	0.10%-0.57%
Forceps	248	0	0%	1.2%-0%
Total	6,600	8	0.12%	

in most other foreign countries.

It was suggested that the incidence of neonatal ICH decreased following the induction of the plastic cup.⁴ Towners⁴ used this instrument with lower incidence than that in the present study. On the other hand, we mainly used a metal Malmstrom cup for V/E during the study period. Subsequently, we also use a soft plastic cup in our hospital.

However, the difference in the incidence of neonatal ICH between deliveries with or without mechanical assistance did not reach statistical significance in the present study. This is inconsistent with previous reports,³⁻⁴ which is probably due to the limited number of deliveries in the present study.

In term infants, reported risk factors of neonatal ICH include a second stage of more than 2 hours, the use of oxytocin, and deliveries with mechanical assistance such as forceps delivery and V/E.⁵ Epidural analgesia prolongs labor and increases the need for oxytocin stimulation.⁶ Furthermore, epidural analgesia also has been found to increase the need for instrumental delivery due to prolonged second-stage labor.⁷⁻⁸ During the study period, 66% of vaginal deliveries were under maternal epidural analgesia. There was a significant difference in the rate of mechanical assistance between deliveries with and without maternal epidural analgesia ($P < 0.001$). However, the incidences of ICH were not statistically significant by modes of delivery (χ^2 analysis, $P = 0.16$), with or without maternal epidural analgesia (χ^2 analysis, $P = 0.537$). This result was similar to the current reports.⁷⁻⁸ With this result, we can perform V/E safely in our hospital.

We found that the clinical symptoms of ICH in neonates are nonspecific including apnea, poor suckling, and tachypnea. Seizures that were the specific symptoms were only 2 cases. For the early diagnosis of neonatal ICH, it is important to detect subtle changes in neonatal behavior, especially in high-risk deliveries.

We experienced 2 cases complicated with secondary hydrocephalus following neonatal ICH. Although most cases with neonatal subarachnoid hemorrhage can be managed with conservative treatment, follow-up by an expert neonatologist is required for these infants.

In conclusion, neonatal ICH in term deliveries in a Japanese perinatal center is essentially similar to the previous reports in other countries. Although the actual

incidence is relatively low, V/E may increase the incidence of ICH. When it is necessary to perform V/E, it is necessary to be especially careful. Neurologic work-up is necessary for infants born by V/E, when nonspecific symptoms such as apnea, poor suckling, and tachypnea were observed.

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Conflict of interest

The authors have no conflicts to disclose.

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