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Birth injuries in newborn: A prospective study of deliveries in South-East Nigeria

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Birth injury is an important cause of short and long-term deformity and disability in children. It is becoming an increasing source of litigation in developing countries. Exploring the magnitude of the problem in a resource-limited setting, and, identifying associated factors, will help reduce its occurrence. This surveillance for birth injuries is a 4-year prospective study conducted in the Enugu State University Teaching Hospital (ESUTH) between 2013 and 2017. Newborns with birth injuries and controls delivered around the same time with similar clinic-anthropometric parameters were enrolled for this study. One thousand nine hundred and twenty newborns were seen during the study period. Forty-six birth injuries were recorded giving in-hospital incidence rate of 24.0 (CI 17.3-30.9) per 1000 live birth. Majority (64.1%) of the injuries seen were related to the scalp. The commonest birth injuries encountered included Caput Succedaneum (41.2), Cephalohematoma (22.9), Erb's Palsy (17.4), and shoulder dislocation (6.5). One case fatality (2.5%) due to skull fracture secondary to forceps delivery was noted. Birth weight (P=0.034), perinatal asphyxia (P=0.001) and prolonged labour (P=0.001) were significantly associated with birth injuries in the newborns surveyed. Birth injury remains a common and serious medical issue in our setting. Being proactive during antenatal care and labour could go a long way in minimizing the incidence of birth injuries and its consequences on children especially in the presence of risk factors such as high birth weight, perinatal asphyxia and prolonged labour.

Key words: Birth injuries, newborns, delivery, Enugu.

INTRODUCTION

Birth injuries are mechanical and physiological adverse events that occur at birth. These injuries may occur during labour, at delivery, or after delivery in neonates that require resuscitation in the delivery room (Papanagiotou et al., 2009). They could be minor and self-limited problems such as laceration and bruising, or severe injuries that may result in significant neonatal morbidity or mortality (Papanagiotou et al., 2009). Commonly encountered injuries include soft tissue, musculoskeletal, spinal cord and peripheral nerve injuries (Baskett et al., 2007). The overall incidence of birth injuries in most developed countries has drastically declined due to improvements in obstetric care and prenatal diagnosis (Parker, 2005). However, in resource limited settings, the decline has been less remarkable (Barry, 2008). Reported incidence rate of birth injuries

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varies extensively in developing countries and depends on the methodology used in its assessment (Levine et al., 1984; Perlow et al., 1996).

Review of available literatures revealed that a wide range of factors such as macrosomia, breech presentation, head circumference, shoulder dystocia, neonatal height and maternal factors (such as increasing age and parity, pelvic abnormality etc) all increase the risk of birth injuries. Other factors such as induction of labour, prolonged labour and instrumental delivery may also contribute to birth injury in newborns (Alexander et al., 2006; Awari et al., 2003). In some cases, despite best the obstetric care and absence of risk factors, birth injuries could still occur (Barry, 2008). Because most birth injuries are preventable, knowledge of the pattern of birth injury and the related factors can serve as a guide for obstetricians and other birth attendants in planning safer delivery programs for mothers. It could also be of immense benefit to the neonatologist in case management and prognostication. Against this backdrop, the authors set out to document the pattern of birth injuries and related risk factors in Enugu South-East Nigeria.

MATERIALS AND METHODS

Study area

The study was carried out in the Special Care Baby Unit (SCBU) of Enugu State University Teaching Hospital (ESUTH), a tertiary health care facility situated in Enugu metropolis, south-eastern Nigeria. ESUTH serves as a referral center for specialized obstetrics and newborn services for the entire state and its environs. The SCBU is in close proximity with the labour ward to ease communication and prompt transfer of babies that may need resuscitation at birth.

Study design

This is a prospective analytical study conducted over a 4-year period from January 2013 to January 2017. Newborn babies presenting with birth injury were consecutively enrolled at presentation after obtaining a written informed consent from the parents and/or caregivers. Diagnosis of birth injury was made after clinical examination and/or radiological assessments where indicated. Once the diagnosis and type of birth injury was confirmed, further information concerning the gender, presence or absence of prolonged labour, mode of delivery, place of birth, gestational age at birth, birth weight and presence or absence of asphyxia were documented in a questionnaire developed specifically for the study. For every newborn with birth injury enrolled, at least 2 others admitted for other reasons other than birth injury with as close clinico-anthropometric characteristics as possible to the case were also enrolled to serve as controls.

Measures

(1) Birth injury: Diagnosis of birth injury was made by clinical evidence of physical adverse events to a newborn during or just after birth. This was done by clinical assessment of a neonatologist or resident doctor with or without radiological assessment to confirm the diagnosis.
(2) Prolonged labor: For the sake of this study, was defined as labor lasting more than 12 h from start of regular contractions to the delivery of the baby.
(3) Perinatal asphyxia: was defined as clinical evidence of inability to initiate spontaneous breathing, need of resuscitation after birth and/or an Appearance-Pulse-Grimace-Activity-Respiration (APGAR) score of less than 7 at five and 10 minutes after delivery.
(4) Gestation at delivery: This was classified as ‘term’ delivery if baby was born after 37 completed weeks of gestation, and ‘preterm’ if delivery was before 37 completed weeks.
(5) Birth weight: This was categorized as low, normal and large if birth weight was < 2.5 kg, 2.5-4.0 kg and > 4.0 kg respectively.
(6) Place of delivery: Babies delivered in ESUTH were grouped as ‘inborn’ while those delivered outside and referred to ESUTH were grouped as ‘outborn’ babies. Additional information on the latter group of neonates was acquired by visiting their place of birth or via telephone calls.

Data handling and analysis

The above measures were documented at presentation in the relevant sections of the questionnaire and subsequently transferred into a Microsoft Excel Sheet. Distribution of the measures of these variables were analyzed and recorded in appropriate statistical units. The chi-square analysis was used to assess initial associations between the demographic parameters of newborns and birth injuries in cases and controls. Binary logistic regression analysis was later used to predict how the significant parameters on chi-square analysis determine birth injuries in these newborns. Measures of this association was presented as odd ratios (OR) and 95% confidence intervals (95% CI). Data analysis was done using IBM® SPSS version 18.0 (SPSS Inc, Chicago, IL) and statistical significance was set at $P \leq 0.05$. Respondents with grossly missing information were excluded from the data analysis

Ethical consideration

Ethical clearance was obtained from the ESUTH Ethics Committee. Before recruitment of each subject, informed consent was also obtained from every mother or caregiver whose babies were enrolled in this study. Participation in the study was entirely voluntary, and no financial inducement whatsoever was involved. Participants were informed that voluntary withdrawal at any stage of interaction was guaranteed for them without any adverse effect to themselves or their baby. All information was handled with strict confidentiality.

RESULTS

Characteristics of enrolled new-borns

A total of 1920 newborns were admitted during the study period. Of these, 46 birth injuries were encountered in 40 newborns resulting to an hospital incidence rate of 24.0 (CI 17.3-30.9) per 1000 new-borns admitted. Table 1 shows the characteristics of new-borns surveyed. Approximately 45% were delivered in the hospital where the study was conducted. The number of males was twice the number of females enrolled and 94.8% of neonates were full-term. Majority (63.4%) of the babies

Table 1. Demographic characteristics of new-borns surveyed for birth injury.

Characteristic	Variable	Number (n)	Percentage
Birth injury (n=134)	Cases	40	29.9
	Controls	94	70.1
Gender (n=134)	Male	89	66.4
	Female	45	33.6
Gestation at delivery (n=134)	Term	127	94.8
	Preterm	7	5.2
Mode of delivery (n=134)	SVD†[1]	85	63.4
	Caesarean section	47	35.1
	Assisted†[2]	2	1.5
Birth weight (n=134)	< 2.5 kg	17	13.2
	2.5-4.0 kg	95	73.6
	> 4.0 kg	17	13.2
Prolonged labour (n=130)	Yes	29	22.3
	No	101	77.7
Perinatal Asphyxia (n=130)	Yes	71	53.8
	No	61	46.2
Place of delivery (n=134)	Inborn	60	44.8
	Out-born	74	55.2

†[1] Spontaneous vertex delivery; †[2] Vacuum/forceps.

were born via spontaneous vertex delivery with 2 (1.5%) requiring forceps to assist delivery. Majority of the new-borns (73.6%) had normal birth weight on delivery. Approximately twenty-two percent (22.3%) of the new-borns enrolled had prolonged labour and while 53.8% had perinatal asphyxia.

Table 2 shows the mean age and weight of enrolled newborns. The mean age of new-borns with birth injury was not significantly different from that of the controls 1.68 ± 1.59 vs. 2.07 ± 1.74; [t=0.023, P=0.982] while the mean birth weight of cases was significantly higher than those of the controls 3.53 ± 0.56 vs. 3.15 ± 0.78; [t=2.759, P=0.007].

Parameters associated with birth injuries

Table 3 shows a cross-tabulation of birth injuries and related clinico-anthropometric parameters of new-borns surveyed. Birth weight (P=0.034), prolonged labour (P=0.001) and perinatal asphyxia (P=0.001) were significantly related to incidence of birth injuries in these new-borns. However, after adjusting for other parameters on logistic regression, birth weight did not significantly predict birth injury in these new-borns (Table 4). Prolonged labour and perinatal asphyxia on the other hand retained statistical significance after adjusting for other study parameters. New-borns without a history of prolonged labour were 0.02 less likely than those with prolonged labour to experience birth injuries (OR 0.02, CI 0.001- 0.089). In other words, prolonged labour increased the risk of birth injuries in surveyed new-borns by a factor of 50. Similarly, new-borns with perinatal asphyxia were 6.9 times more likely to be injured during delivery compared to those without perinatal asphyxia (OR 6.90, CI 1.774- 26.817). Other parameters examined in this study such as gender (OR 1.81, CI 0.518-6.339), gestational age (OR 2.26, CI 0.401 - 12.661) and mode of delivery (OR 2.28, CI 0.528-9.056) were not significantly predictive of birth injuries during delivery in surveyed new-borns.

Pattern of birth injuries encountered among surveyed new-borns

Table 5 shows a list of birth injuries encountered in surveyed new-borns. The scalp was the most frequently

Table 2. Baseline statistics of cases and control surveyed for birth injury.

Parameter	Birth injury	Mean ± SD†[1]	SE†[2]	Min value	Max value	Range	t-value (P)
Age (days)	Cases	1.68 ± 1.59	0.25	1.0	8.0	7.0	0.023
	Controls	2.07 ± 1.74	0.18	1.0	9.0	8.0	0.982
Weight (kg)	Cases	3.53 ± 0.56	0.09	2.1	4.6	2.5	2.759
	Controls	3.15 ± 0.78	0.08	0.7	5.5	4.8	**0.007**

†[1] Standard deviation; †[2] Standard Error; Bold P is statistical significant.

Table 3. Cross-tabulation of cases and control of birth injury and selected parameters.

Characteristic	Variable	Birth Injury		χ^2
		Cases	Controls	*P-value*†[1]
		n (%)	n (%)	
Gender(n=134)	Male	31 (35)	58 (65)	3.14
	Female	9 (20)	36 (80)	0.076
Gestation at delivery (n=134)	Term	39 (31)	88 (69)	0.855
	Preterm	1 (14)	6 (86)	0.355
Mode of delivery (n=134)	SVD†[2]	22 (26)	63 (74)	5.734
	Caesarean section	16 (34)	31 (66)	0.057
	Assisted	2 (100)	0 (0)	
Birth weight (n=129)	< 2.5	2 (5)	15 (17)	6.776
Prolonged labour (n=130)	2.5-4.0	29 (73)	66 (74)	**0.034**
	> 4.0	9 (22)	8 (9)	
Perinatal Asphyxia (n=132)	Yes	25 (86)	4 (14)	63.82
	No	11 (11)	90 (89)	**0.001**
Place of delivery (n=134)	Yes	33 (47)	38 (53)	23.46
	No	5 (8)	56 (92)	**0.001**
Place of delivery (n=134)	Inborn	21 (35)	39 (65)	1.376
	Outborn	19 (26)	55 (74)	0.249

† [1] Yates correction applied where appropriate, †[2] SVD Spontaneous Vertex Delivery.

affected part of the body during delivery. Caput succedaneum 19 (41.2%) and Cephalohematoma 11 (23.9%) were the commonest injuries seen among new-borns surveyed. Injury to the brachial nerve plexuses resulting in Erb`s paralysis was seen in 8 (17.4%) of the newborns. The right upper limb was affected in majority of the cases 5/8 (62.5%). Right shoulder dislocation occurred in 3 (6.5%) cases. Other less encountered birth injuries included fracture of the femur 2 (4.4%), skull fracture 1 (2.2%), facial nerve injury 1 (2.2%) and sub-conjunctiva haemorrhage 1 (2.2%). The skull fracture was caused by use of forceps during labour and the newborn died days later in the neurosurgical unit. All others were managed appropriately, stabilized and discharged home. This gave a case fatality of 2.5%.

DISCUSSION

The incidence of birth trauma in our study was approximately 24 per 1000 admitted new-borns. The incidence rate seen in our study was considerably higher

Table 4. Binary logistic regression analysis of birth injury and selected parameters.

Parameter	Reference	OR (95% CI) †[1]	P-value
Gender	Male	1.81 (0.518 - 6.339)	0.352
Gestational age	Term	2.26 (0.401 - 12.661)	0.692
Mode of delivery	SVD†[2]	2.28 (0.528 - 9.056)	0.270
		Not computable†[3]	-
Birth weight	> 4 kg	1.07 (0.103 - 11.063)	0.958
		1.36 (0.245 - 7.603)	0.723
Prolonged labour	Yes	0.02 (0.001 - 0.089)	**0.001**
Perinatal asphyxia	No	6.90 (1.774 - 26.817)	**0.005**
Place of delivery	Inborn	2.37 (0.620 - 9.056)	0.207

†[1]Adjusted odds ratio and 95% Confidence Interval; Bold P is statistically significant; †[2] SVD Spontaneous Vertex Delivery
†[3] The OR and CI of assisted delivery category was not computable probably due to small sample size.

Table 5. Types of injuries encountered in cases of birth injury.

S/N	Birth injuries encountered	Number (n)	Percentages	Incidence rate (CI) †
1	Caput succedaneum	19	41.2	**9.9** (5.5 -14.3)
2	Cephalhematoma	11	22.9	**5.7** (2.3 -9.1)
3	Erb's palsy	8	17.4	**4.2** (1.3 -7.1)
4	Shoulder dislocation	3	6.5	**1.6** (0.2 -3.3)
5	Fracture of the femur	2	4.4	**1.1** (0.4 -2.5)
6	Sub-conjunctiva haemorrhage	1	2.2	**0.5** (0.2 -1.3)
7	Facial nerve injury	1	2.2	**0.5** (0.2 -1.3)
8	Skull fracture	1	2.2	**0.5** (0.2 -1.3)
Overall		**46**	**100**	**24.0** (17.9 -30.9)

† per 1000 new-borns admitted; CI- Confidence interval.

than the 2-7 per 1000 birth reported in a hospital-based retrospective study in Oshogbo in South-West Nigeria (Oluwadiya et al., 2004). The Oshogbo study being a retrospective study is better fitted in calculating prevalence rather than incidence of this condition. A prospective study by Parker (2005) that was methodologically similar to ours reported a birth injury incidence rate of 15.4 per 1000 live birth which is comparable to our reported incidence.

Though statistical significance was not attained, the use of forceps comparatively accounted for a higher proportion of birth injury (100%) compared to spontaneous vertex (24%) and operative deliveries (36%). It is well known that the use of forceps or vacuum pumps, especially at the wrong time during labour and/or by inexperienced medical personnel, can considerably increase the risk of injuries to new-borns and mothers (Yvonne et al., 2017).

Our study also showed that birth weight, prolonged labour and perinatal asphyxia were significantly associated with occurrence of injury to the new-borns during birth. This corroborates the findings of two separate studies conducted in India and Iran, where it was reported that fundal pressure, shoulder dystocia, neonatal weight, prolonged labour and obstructed labour were significant determinants of birth injuries in new-borns (Ray et al., 2016; Masoumeh et al., 2015). It is fair to assume that higher birth weight is a predisposition to prolonged labour that could in turn lead to perinatal asphyxias and use of assisted and/or operative delivery methods, which may ultimately lead to birth injury and/or still birth (Linder et al., 2014; Moraitis et al., 2014). It therefore comes as no surprise that these variables were important determinants of birth injuries in our study. However, it is worth noting that after confounding factors such as mode of delivery and other new-born variables were adjusted for on multiple logistic regression analysis, birth weight lost significance as a determinant of birth injury. This may be indicative of the fact that in spite of high birth weights, birth injuries could still be prevented in babies if deliveries are appropriately planned.

We reported an incidence rate of 9.5 cases per 1000 admitted newborns for caput succedaneum and 5.7 cases per 1000 admitted newborns for cephalohematoma in our study, compared to incidence rate of 1.28 and 1.32 cases per 1000 births of cephalohematoma and cranial

injuries generally reported in a study conducted in the town of Kashan in Iran (Masoumeh et al., 2015). The lower incidences reported in the Iran study compared to the present study may be reflective of the superior obstetrics care in Iran, which has an average mortality ratio of 25 compared to 814 deaths per a 100,000 live birth in Nigeria according to the World Health Organization indicators of obstetric care report in 2015 (WHO, UNICEF, UNFPA, World Bank Group, 2015).

Other injuries encountered in our study included erb's paralysis, shoulder dislocation, fracture of the femur, sub-conjunctiva haemorrhage and facial nerve palsy which have been reported in various studies within and outside Nigeria (Yvonne et al., 2017; Ray et al., 2016; Masoumeh et al., 2015; Masoumeh et al., 2015; Pollina et al., 2001). A skull fracture which is a rare form of scalp injury was encountered in our study as a result of forceps delivery. A case report in India also reported two cases of depressed skull fracture following instrumentation with forceps during spontaneous vertex delivery (Muhammed et al., 2013). The authors of the case report acknowledged that both cases posed a management challenge to the neurosurgical unit of the hospital as did the case encountered in this study. Contrary to our study, another case report by David et al. (2015) described a new-born with non-traumatic skull fracture during a vaginal delivery. The cause of the 'ping-pong' fracture was not immediately clear to the authors.

Finally, our study reported a case fatality of 2.5% in new-borns with birth injury. This is far lower than the 8.4% incidence rate reported in a retrospective study in South-west Nigeria (Oluwadiya et al., 2004). This difference may likely be due to the higher number of new-borns with more severe intracranial injuries in the referenced study compared to ours. The strength of our study lies in the fact that it was a surveillance study in which we prospectively enrolled and followed up new-borns delivered with birth injuries over 4-year period. However, like every hospital-based study, the incidence rate of birth injuries reported in this study may be prone to the Berkson bias.

Conclusion

The findings of our study show that incidence of birth injuries in new-borns is relatively high in our setting. Increased surveillance for risk factors during antenatal care and in labour, in addition to the application of safe delivery practices, could help reduce the burden of birth injuries on new-borns, its families, and the healthcare system in general.

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CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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