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RESEARCH ARTICLE

RISK FACTORS OF BIRTH TRAUMA OF NEW BORN BABIES IN AL-KANSAA MATERNITY AND PEDIATRIC TEACHING HOSPITAL IN MOSUL

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ABSTRACT

Background: Birth trauma can be defined as injury to infant resulting from mechanical forces (such as compression or traction) during the process of birth. **Objectives:** To identify the risk factors associated with birth trauma and to find out the most common type of birth trauma in our locality. **Patients and methods:** A prospective case control study conducted over a ten months period from the 1st of March to the 31st of December 2006 in Al-kansaa maternity and pediatric teaching hospital in Mosul on 240 babies aged between (0-72 hours) of both gender (120 babies delivered with birth trauma and 120 babies delivered without birth trauma for the control group). **Results:** Birth trauma is found in 0.8% of the total deliveries in our study. Trauma of cranium was the most Common type of birth trauma, of which caput succedaneum (42.5%) was the most common one. **Conclusion:** The significance of any of the risk factors whether related to mothers, the babies or the labor, leads us to identify the birth trauma earlier that prompts us to urgent diagnostic and therapeutic measures to decrease the morbidity and mortality.

INTRODUCTION

Birth trauma is defined as injury to infant resulting from mechanical forces (such as compression or traction) during the process of birth (Tsuji, 1997). Although the majority of birth injuries are minor and often unreported, occasionally birth injuries may be severe as to be fatal or leave the child with a permanent disability or even death (Uhing, 2005). They may occur because of inappropriate or deficient medical skills and attention, but they also can occur despite skilled and competent obstetric care. Although various factors ranging from infant – related factors (very low birth weight infant or extreme prematurity, fetal macrosomia, fetal anomalies and twin particularly the second one), maternal related factors (primigravida, maternal – pelvic anomalies, poor maternal health, maternal age, ((very young and old))) and labor – related factors (prolong or extremely rapid labor, deep transvers arrest, use of mid cavity forceps or vacuum extraction, version, and extraction), all have been highlighted as predisposing factors, (McIntosh and Stenson, 2003) there are no uniform agreements on the role of specific factors. For instance, while some reports suggest that fetal macrosomia and breech delivery predispose to birth trauma (Roberts *et al.*, 1995), others do not (Weeks and Pitman, 1995). These disagreements represent inter-center difference in experience and study methodology. The average incidence of birth injuries 2-7 case per 1000 live births (Stoll and Kliegman, 2000). Most of birth trauma are self – limiting - and have a favorable

outcome. Nearly one half are potentially avoidable with recognition and anticipation of obstetric risk factors. Infant outcome is the product of multiple factors.(7) Mortality/morbidity: From 1970-1985, rates of infant mortality due to birth trauma fell from 64.2 to 7.5 death per 100,000 live births, a remarkable decline of 88%. This decrease reflects in part, the technologic advancements that allow today's obstetrician to recognize birth trauma risk factors using ultrasonography and fetal monitoring prior to attempting vaginal delivery. The use of potentially injurious instrumentation, such as midforceps rotation and vacuum delivery, has also declined. The accepted alternative is a cesarean delivery (6).

Aim of the study

- To identify the risk factors associated with birth trauma.
- To find out the most common type of birth trauma in our locality.

PATIENTS AND METHODS

This was a prospective case control study conducted at the Neonatal Intensive Care Unit (NICU) of AL-kansaa maternity and pediatric teaching hospital in Mosul. Sample collected over ten months period from the 1st of March to the 31st of December 2006. In total 240 babies of both gender, aged between 0-72 hours, with gestational age range between 28-42 weeks (120 babies with birth trauma and 120 babies with no

birth trauma as control group) were included in this study. Our aim to identify the risk factors for birth trauma in the study group, compared with the control group. All information about maternal risk factors were taken from mothers record at obstetric unit including, (maternal age, parity, chronic illness and history of contracted pelvis). All information about labor were taken from doctors in the obstetric unit including, (type of delivery "normal vaginal delivery or caesarean section or instrumental delivery using vacuum or forceps", duration of second stage of labor, fetal presentation at labor and history of shoulder dystocia at labor). All information about neonatal risk factors were taken from the doctors in the NICU including, (gender, birth weight, gestational age, number of gestation" single or being member of twin"). The control group including babies who admitted to NICU of the same hospital for other than birth trauma. All babies were examined physically to assess gestational age, gender and full systemic examination including, birth weight, neurological examination with neonatal reflexes. Investigation which were done to the patients according to the type of birth trauma including the following:

- Skull X-ray.
- X-ray of the extremities.
- X-ray of the shoulder Joint and clavicle.
- Cerebral Ultrasonography.
- CT scan of the brain.

Statistical analysis:-The results were analyzed by statistical analysis using Chi square and significance was considered if P-value <0.05.

RESULTS

During the period of our study which extended to ten months, the total number of deliveries to this hospital was 14800 from which 190 were still births. The total admissions to NICU in this period were 793.

From our study we found the following results:

The influence of babies risk factors on birth trauma as follows:

- Gender was not statistically significant as a risk factor for birth trauma (P = 0.70) as shown in table (1).
- There was a statistical significant association between birth trauma and birth weight (P = 0.048), gestational age (P = 0.025) and multiple gestations (P = 0.02), as shown in table (2), (3) and (4) respectively.

The influence of maternal risk factors on birth trauma as shown in table (5):

- Maternal age is not significantly reflected on babies who had birth trauma (P = 2.0).
- **Gravidity:** There was a statistical significant association between birth trauma and babies from mothers who are primigravida (P=0.0007).
- **Maternal Diseases:** There was no significant association between maternal hypertension and the occurrence of birth trauma (P = 0.54), on the other hand there was a significant association between maternal diabetes mellitus and the occurrence of birth trauma (P=0.03).

- **Contracted Pelvis:** There was increase incidence of birth trauma in babies born from mothers having history of contracted pelvis (P<0.019).

The influence of labour risk factors on birth trauma as shown in table (6):

- **Type of delivery:** There was a significant statistical association between birth trauma and type of delivery, there was increase incidence of birth trauma with instrumental delivery (P<0.0001).
- **Duration of second stage of labor:** There was increase incidence of birth trauma with prolong labor in both primi and multi mothers (P<0.0001).
- **Fetal Presentation:** There was increase incidence of birth trauma with abnormal fetal presentation at labour (breech or face presentation) (P = 0.003).
- **Shoulder Dystocia at Labour:** There was increase incidence of birth trauma with shoulder dystocia at labour (P = 0.0001).

Table (7) shows type of birth trauma and their percentage

- In total 96 (80%) patients had trauma of the cranium which considered the most common type including the following, caput succedaneum (42.5%), erythema, abrasions and ecchymosis of the head and neck (15.83%), cephalhematoma (10%), subconjunctival and retinal hemorrhage (Hg) - (5.83%), wounds and laceration of the scalp (1.66), liner fracture of the skull (0.83%) and intracranial hemorrhage (I.C.H) (3.33%).
- **Extremities injury,** in total 17 (14.16%) patients had trauma to the extremities including the following, ecchymosis of the lower limbs (7.5%), ecchymosis of the upper limbs (3.33%) Fractures of the extremities 4 (3.33%) patients had fracture of the extremities (two of them had fracture of the right humerus other one had fracture of the left humerus and one had fracture of the left femur).
- 2 patients (1.66%) had fracture of the right clavicle.
- Regarding the peripheral nerve injury:

In total 5 (4.2%) patients had nerve injury including the following:

Erb – Duchenne paralysis (1.66%), Klumpke – paralysis (1.66%) and facial nerve palsy (0.83%). Radiological and Ultrasonographic Finding of patients with birth trauma

- Skull X – ray was done to all patients with trauma to the cranium, one patient had linear fracture of the skull this patients also had ultrasound and CT – scan of the brain the result was negative.
- X – ray of extremities, four patients had positive findings including (two patients had fracture of the right humerus, one patient had fracture of the left humerus and one had fracture of the left femur).
- 3.X – ray of the clavicle two patients had fracture of the right clavicle.
- Regarding other investigations, cerebral Ultrasonography and CT – scan of the brain were done to nine patients who were suspected clinically to have ICH and four of them had positive findings Intraventricular hemorrhage (IVH).

Table 1. Gender difference for the study and control groups

Gender	Study group	Control group	Significance
Male	70	67	$\chi^2=0.15$ P = 0.70
Female	50	53	

Table 2. The relation between birth weight of the study and control groups with birth trauma

Birth weight/ kg	Study group	Control group	Significance
<2.5	23	36	$\chi^2=6.01$ P = 0.048
2.5-4.34	90	82	
>4.34	7	2	

Mean birth weight in the study groups = 3.104 ± 0.735 .

Mean birth weight in the control groups = 2.81 ± 0.734 .

Table 3. The risk of gestational age for the study and control groups on birth trauma

Gestational age	Study group	Control group	Significance
<37	30	15	$\chi^2=5.13$ P = 0.025
≥ 37	90	105	

Table 4. The relation between number of gestation for the study and control groups with birth trauma

Number of gestation	Study group	Control group	Significance
Single	107	116	$\chi^2=5.13$ P = 0.025
Member of twin	8	4	

DISCUSSION

The total deliveries during the 10 months of the study in the hospital were 14800 (7576 males, 7224 females) with 190 still births. 5.4% (793) of total live births require admission to NICU. Birth trauma is found in 0.8 % of the total deliveries. No case fatality rate was reported in our study. This could be due to that overall, 3.7/100,000 infants die of birth trauma as reported by Tsuji M.K. in 1997(1). Birth trauma is estimated to be between the sixth to tenth leading cause of infants' mortality in the U.S., it is under reported and often misdiagnosed (8,9). Neonatal risk factors: Our study shows that males were more often affected by birth trauma than females, male: female ratio was 1.4: 1. The sex difference was not statistically significant ($p = 0.70$).

Regarding birth weight, our study shows its significant influence in the occurrence of birth trauma, especially those babies with birth weight more than 4.34 kg (macrosomic babies) which is similar to other studies (Tsuji MK, in 1997(1), Kliegman R.M. in 2000(6), McIntosh N. in 2003(3), Ghorashi, *et al.*) (2005). Our study showed that there is increase incidence of birth trauma in preterm babies. Hayashi R., Dennen P.C. in 1999(11) said that in infant weighing below 1500 grams forceps delivery offers no advantage, and may in fact be deleterious due to an increase incidence of intracranial bleeding, use of the ventous carries the same risk; vacuum extraction is probably best avoided at less than 34 weeks. In low birth Weight infants (1500-2500 grams) assisted vaginal delivery is more widely accepted but should be managed with caution and minimal force. In multiple gestation (i.e. those being member of twin) there was increase in the incidence of birth trauma in our study ($p = 0.02$), which is similar to the fact reported by McIntosh N. in 2003.

This could be due to decrease in the available fetal movable space, which increases the likelihood of malpresentation (Rosenberg *et al.*, 2001). Maternal risk factors'. Maternal age, in our study showed no significant effect on occurrence of birth trauma ($p=0.2$). This could be either due to small number of sample or less common marriage in very young females. Regarding gravidity our study showed that increase incidence of birth trauma in babies from mothers who are primigravida ($P=0.0007$). The reason adduced for this increase incidence among the nulliparous due to their inexperience (about pregnancy, delivery and their complication), not attending the antenatal clinic, history of pelvic contraction and some form of bony and soft tissue dystocia (Rosenberg, 2001; Enyida, 2005). Regarding chronic illness of the mother, hypertension showed no significant effect on the occurrence of the birth trauma ($p=0.54$). Diabetes mellitus has significant effect ($p = 0.03$) on increase in the incidence of birth trauma, this may be related to the poor control of our diabetic patients which results in delivery of a large for gestational age babies (macrosomia) and traumatic birth injury (e.g. brachial nerve. injury and shoulder dystocia), similar to Campbell S., Lees C. in 2000 (Campbell *et al.*, 2000).

There is increase incidence of birth trauma in babies who born from mothers having history of pelvic anomalies or history of contracted pelvis ($p < 0.019$) as maternal pelvis size and type (android, anthropoid and platypelloid) will have an effect on the birth canal size and shape and the forces encountered on the emerging head and spine (Curran, 1981). Risk factors related to labor: Our study showed that incidence of birth trauma increase with use of instrumental delivery (using vacuum or forceps), ($p < 0.0001$). All babies delivered by vacuum extraction got birth trauma (100%) which represent 25% of all deliveries in our study and this much differs from the study of Teng F.Y., Sayre J.W. in 1997 who found 21% of newborn delivered by vacuum extraction got birth trauma. All babies delivered by forceps got birth trauma (100%) and this represent (3.5%) of all deliveries in our study, which much differs from the incidence of birth trauma from the use of the forceps reported by Chiswick M.L., James D.K. in 1979 who found the incidence of birth trauma attributable to the use of the forceps (15.1%). This may be related to differing management of labor in different countries as reported by Campbell S., Lees C. in 2000.

Our study showed that prolong second stage of labor more than half an hour in multiparous women and more than one hour in primigravida was significantly increasing the incidence of birth trauma ($p < 0.0001$), this can be explained by the prolong second stage of labor will increase the incidence of instrumental delivery (use of vacuum or forceps) this was documented by many other studies (Campbell, 2000; Rubina Mustafa, 2002; Myles, 2003; Cheng *et al.*, 2004). A significantly high portion of babies suffered birth injuries due to prolong labor and use of extraction device (Cheng *et al.*, 2004). Abnormal fetal presentation at labor (like breech or face presentation) was significantly increasing the incidence of birth trauma as found by our study ($p = 0.003$). This can be explained by the abnormal fetal presentation will prolong the second stage of labor and this will increase the incidence of instrumental deliveries and this was documented by many other study (Campbell, 2004; Ckiswick, 1979). The incidence of shoulder dystocia at labor in our study was 6% which differs from that reported by Johanson R. in 1999 who found the incidence of shoulder dystocia was 2%.

Table 5. Influence of maternal risk factors on birth trauma

Maternal risk factors	Category	Study group	Control group	Significance
Mother age in years	<16	2	1	$\chi^2=3.19P = 2.0$
	16-35	105	113	
Gravida	>35	13	6	$\chi^2=11.42P = 0.0007$
	primi	66	40	
hypertension	Multi	54	80	$\chi^2=0.38P = 0.54$
	Yes	15	12	
Diabetes mellitus	No	105	108	$\chi^2=4.65P = 0.03$
	Yes	7	1	
History of contracted pelvis	No	113	119	$\chi^2=5.60P < 0.019$
	Yes	10	2	
	No	110	118	

Table 6. Influence of labor risk factors on birth trauma

Labor risk factors	Category	Study group	Control group	Significance	
Type of delivery	NVD	52	82	$\chi^2 = 42.06$ P<0.0001	
	CS	33	38		
	Vacuum	31	-		
	Forceps	4	-		
Duration of second stage of labor in hours	Multi	< 1/2	25	58	$\chi^2 = 86.50$ P<0.0001
		≥ 1/2	29	2	
	Primi	< 1	26	59	
		≥ 1	40	1	
Fetal presentation at labor	Cephalic	102	117	$\chi^2=11.69$ P= 0.003	
	Breech	12	2		
	Face	6	1		
Shoulder dystocia at labor	Yes	8	-	$\chi^2= 32.24$ P = 0.0001	
	No	112	120		

Table 7. Types of birth trauma and their percentage in our study

Types of birth trauma	Category	Number of patients	Percentage %
Cranium	Caput succedaneum	51	42.5%
	Erythema, abras-ion, ecchymoses of the head and neck	19	15.83%
	cephalhematoma	12	10%
	Subconjunctival and retinal Hg.	7	5.83%
	Scalp wounds and laceration	2	1.66%
	Fracture of the skull	1	0.83%
Intracranial hemorrhage	IVH	4	3.33%
Ecchymoses of the extremities	Lower limbs and pelvis	9	7.5%
	Upper limbs	4	3.33%
	Extremities	4	3.33%
Fractures	Clavicle	2	1.66%
	Nose	-	-
	Erb-Duchenne paralysis	2	1.66%
Peripheral nerve injury	Klumpke-paralysis	2	1.66%
	Facial N. palsy	1	0.83%
	Phrenic N. paralysis	-	-
Viscera	Liver, rupture spleen	-	-

The presence of shoulder dystocia at labor was increase the incidence of birth trauma in our study ($p < 0.0001$). Erb's palsy is the commonest brachial plexus injury (17,23) due to shoulder dystocia, other injuries in the form of fractured clavicle or humerus can also Happen (Johanson, 1999).

Types of birth trauma: Regarding the types of birth trauma, our study showed that trauma of the cranium was the most common type 80%, of which (caput succedaneum 42.5%, erythema-abrasions-ecchymosis of the head and neck 15.83%, cephalhematoma 10%) were the most common types as documented by many other studies(1,3,6,24). Less common types of trauma of the cranium were subconjunctival and retinal Hg (4.16%), scalp wounds and lacerations (1.66%). We had one case with fracture of the skull result from vacuum extraction that is similar to a case reported by Papaefthymiou 1996, reported a case of skull fracture following birth trauma caused by vacuum extraction.

The vacuum extractor exerts considerable contraction force, fetal skull fracture can result, and its true incidence may be higher than expected, considering that few neonates with normal neurologic behavior undergo skull X-ray (Hicky, 1996). Four patients (preterm babies) had IVH, in fact all preterm babies should be evaluated with cerebral ultrasonography to detect IVH as reported by Kliegman in 2000, who said that although preterm infants with IVH manifest rapid shock, mottling, anemia, coma or a bulging fontanel, many signs of IVH are non specific or absent. Therefore, it is recommended that the premature infant be evaluated with real-time cerebral ultrasonography through the anterior fontanel to detect IVH. Soft tissue bruising [ecchymosis of lower limbs-pelvis (7.5%) and upper limbs (3.33%)], fractures including fractures of the extremities (3.33%), fracture of the clavicle (1.66%) and peripheral N. Injury (4.16%) was less common than trauma to the cranium as found by our study which was differs from Rosenberg A.A., Thilo E.H. in 2001, who said that most common birth trauma

are soft tissue bruising, fractures (clavicle, humerus, or femur), cervical plexus palsies. Fractures of the extremities (3.33%) more common than fracture of the clavicle as found by our study which differs from others (Tsuji M.K. in 1997, Kliegman R.M. in 2000), who found that fracture of the clavicle more common than fractures of the extremities. No case was reported with visceral trauma this could be due to misdiagnosis as the visceral trauma requires early suspicion by means of ultrasonographic examination as mentioned by Kliegman 2000.

Conclusion

From our study we concluded that; Birth trauma is still a significant problem in our locality causing a lot of morbidity, and the most common type of birth trauma was the trauma of cranium of which caput succedaneum was the most common type. Most common neonatal risk factors that increase the incidence of birth trauma were macrosomia, prematurity and multiple pregnancies. Regarding the maternal side, we have the primigravida, chronic maternal illness like diabetes mellitus, pelvic anomalies or contracted pelvis. Risk factors related to labor we have instrumental delivery, prolonged labor especially the second stage, abnormal fetal presentation and shoulder dystocia at labor. We Recommended proper surveillance at antenatal clinics to pick out high risk mothers and infants who are likely to suffer from birth injuries like macrosomic infant of diabetic mothers, premature infant. Obstetric/delivery practices should be regularly evaluated to reduce birth trauma morbidity and better use of investigations like ultrasound, x-ray, CT scan for early diagnosis and further management of birth trauma.

REFERENCES

- Campbell S., Lees C. 2000. Neonatology, medical diseases complicating pregnancy, operative intervention in obstetrics, labour: Obstetrics by Ten teachers, 17th ed. 344-45: 248-249: 285: 120: 125-7.
- Cheng YW., Hopkins LM., Caughey A.B. 2004. How long in too long: Does a prolonged second stage of labor in multiparous women affect maternal and neonatal outcomes? *Am J Obstet Gynecol.*, 191 (3): 933-938.
- Ckiswick M.L., James D.K. 1979. Kielland's Forceps: associated with neonatal morbidity and mortality. *Br Med J.*, Jan6; 1 (6155): 7-9.
- Curran J.S. 1981. Birth associated injury, clinics in perinatology Feb. Vol.8 (1): 111-127.
- Dennen P.C., Hayashi R. 1999. Assisted vaginal delivery: High Risk pregnancy. James D.k., Steer P.J., Weiner C.P., Gonik B. (ed). 2nd ed.1187-1188.
- Ducarme G., Ceccaldi P.F., Chesnoy V. *et al.*, 2006. (Face presentation: retrospective study of 32 cases at term). *Gynecol obstet Fertil.*, 34:393.
- Enyida C., Nte A. 2005. Mechanical birth injuries in the Niger Delta: A ten year review (1989-1998). *Trop J obstet Gynaecol.*, 22:50-5.
- Faix R.G., Donn S.M. 1983. Immediated management of the traumatized infant. *Clinics in perinatology*, Vol. 10 (2): 487-505.
- Gherman R.B. *et al.*, 2006. Shoulder dystocia: the unpreventable obstetric emergency with empiric management guidelines. *Am J Obstet Gynecol*, 195 (3): 657-672.
- Ghorashi Z., Ahari. H.S., Okhchi A.R., *et al.* 2005. Birth injuries of neonates in Alzahra hospital of Tabriz, Iran. *Pakistan Journal Medical sciences.*, 21(3): 289-291.
- Haerle M., Gilbert A. 20004. Management of complete obstetric brachial plexus lesion. *J pediatr orthop.*, 24. (2); 194-200.
- Hicky K., Mckenna P. 1996. Skull fracture caused by vacuum extraction. *Obstet Gynecol.*, 88 (4 pt 2): 671
- Johanson R. 1999. Malposition, malpresentation and cephalopelvic disproportion: Dewhurst's Text book of obstetrc and Gynecology. Edmonds D.K. (ed). 16th ed. 278: 282: 284-5.287.
- Kliegman R.M. 2002. Fetal and Neonatal Medicine: Nelson Essentials of Pediatrics. Behrman R.E., Kliegman R.M. (ed). 4th ed. 201-3.
- McIntosh N., Stenson B. 2003. The newborn: Forfar and Arneil's textbook of pediatrics. Jtlelms P, Lsmyth R, McIntosh N. editors, 6th ed. London, Oxford, Elsevier, limited. 10: 194-97.
- Myles T.D., Santolaya J. 2003. Maternal and neonatal outcomes: in patients with a prolonged second stage of labour. *Obstet Gynecol.*, 102 (1): 52-58.
- Papaefthymiou G., Oberbauer R., Pendl G. 1996. Craniocerebral birth trauma caused by vacuum extraction: a case of growing skull fracture as a Perinatal complication. *Childs Nerv Syst.*, 12(2):117-20.
- Roberts S.W., Hernandez C., Marberry M.C. 1995. obstetric clavicular fracture: the enigma of normal birth. *Obstet Gynecol.*, 86 (6): 978-81.
- Rosenberg A.A., Thilo E.H. 2001. The Newborn Infant: Current Pediatric Diagnosis and treatment. Hay W.W., Hayward A.R., Levin M.J., Sondheimer J.M. editors. 15th ed. London, WIP, pp.19.
- Rubina Mustafa, Rozina Mustafa, 2002. Perinatal and Maternal outcomes in ventouse versus forceps delivery. *J Coll Physicians Surg Pak.*, 12 (6): 345-7.
- Rusell R.C.G., Williams N., Bustrodemch C.J.K. 2004. Craniocerebral trauma: Baily and Love's short practice of surgery, 24th ed. London, Arnold 43: 604.
- Stoll B.J., Kliegman R.M. 2000. The Fetus and the Neonatal Infant: Nelson Textbook of pediatrics. Behrman R.E., Kliegman R.M., Jenson H.B. (ed). 16th ed. 488-93.
- Teng F.Y., Sayre J.W. 1997. vacuum extraction: dose duration predict scalp injury? *Obstet Gynecol.*, vol. 89 (2): 281-285.
- Tsuji M.K. 1997. Birth trauma: Manual of neonatal care. Cloherty J., Stark A.R. editors. 4th ed. 225-32.
- Uhing M.R. 2005. Management of birth injuries. *Clin perinatol.*, 32:19-38, v.
- Weeks J.W., pitman T., Spinnato J. 1995. 2nd. Fetal macrosomia: Does antenatal prediction affect delivery route and birth outcome? *Am J obstet Gynecol.*, 173: 1215-9.
