Does transport affect the incidence of intraventricular hemorrhage in preterm infants?

Narjes Pishva[1] , Maziar Mortazavi[2]* , Fariba Hemmati[3]

1-Pediatrics Department, Namazi Hospital, Shiraz University of Medical Sciences, Shiraz, Iran
*(Corresponding author: mortazavi@sums.ac.ir, Tel: +98-914-419-1937)
2-Pediatrics Department, Abozar Hospital, Ahvaz Jundishapour University of Medical Sciences, Ahvaz, Iran
3-Pediatrics Department, Namazi Hospital, Shiraz University of Medical Sciences, Shiraz, Iran

Abstract

Objective:
Preterm infants are prone to intraventricular hemorrhage. They may suffer from significant morbidity and mortality particularly in those with high-grade hemorrhage. Our objective was to determine the incidence of intraventricular hemorrhage in premature infants transported to a tertiary center compared with those delivered at the level III facility.
Methods:
We evaluated all premature infants admitted to neonatal intensive care units affiliated with Shiraz University of Medical Sciences from April 2008 through April 2009. Neonatal transports from 20 facilities were compared with those delivered at the same centers' level III facility with respect to intraventricular hemorrhage. Serial neonatal brain sonographies were performed on admission, 7th and 30th day post - admission.
Results:
From a total of 161 premature neonates, 96 were inborn and 65 were outborn. Intraventricular hemorrhage was significantly higher in transported infants (24 of 96 inborn infants or 25% and 36 of 65 outborn neonates or 55.4%) This difference was statistically significant ($p< 0.001$)
Conclusion:
We found that transported neonates had a higher risk for intraventricular hemorrhage compared to those born at the level III facility. Our data emphasizes the importance of improving teams for neonatal transfer. Ideally, high-risk pregnant women should be transferred before delivery to a perinatal center capable of caring for both the mother and infant.
Keywords:
Intraventricular hemorrhage, Neonatal transport, Ppremature

Introduction

Regionalization of neonatal health services is an important aspect of maternal and neonatal health. The level of centralization of neonatal health services has been actively discussed in recent years (1, 2). Philips *et al*. analyzed maternal and neonatal transport during a 3-year period. Neonates were transported to a tertiary perinatal - neonatal center. They found that neonatal survival was significantly greater among the maternal transport patients. The total survival rate for the maternal transfer group was 94.7% versus 79.5% for the neonatal transfer group ($p< 0.001$); in the maternal transport population, the incidence of intraventricular hemorrhage (IVH) was less ($p= 0.041$) (3). In another study of the effect of transport on the rate of severe IVH in very low birth weight infants, the authors found that there were 37 cases (11%) of grade III or IV intraventricular hemorrhage in the 329 very low birth weight infants, 27 of 285 of those delivered in the level III center (9%) and ten of 44 outborn neonates (23%) (4). In the last decade there has been an overall improvement in neonatal survival. Much of it is related to regionalize perinatal care. (5, 6) We assessed the incidence of IVH in premature outborn infants transported to a tertiary center compared

with those delivered at the same tertiary center.

Methods

This was a prospective cohort study in premature infants. All premature (<37 weeks gestational age) infants admitted to neonatal intensive care units of the Namazi and Hafez hospitals affiliated with the Shiraz University of Medical Sciences from April 2008 through April 2009 were studied. Infants with major congenital abnormalities were excluded from our study.

We compared the incidence of IVH of neonates delivered at hospital with NICU (Level III facility) with neonates of similar gestational age who were transported from 20 centers after birth. Serial brain sonographies were performed on the 96 inborn and 65 outborn neonates at the time of admission. Brain sonography was performed upon admission and on the 7th and 30th day after birth. Ultrasonography was performed in sagittal and coronal planes with 7.5 and 10 MHz transducers (Honda Hs - 2000). Brain sonography was used for diagnosis of IVH. All brain sonographies were performed by one expert neonatologist and also checked by one expert radiologist. Hemorrhage was graded as follows :

Grade I: Germinal matrix hemorrhage with no or minimal IVH (<10% of ventricular area on parasagittal view)

Grade II:IVH (10-50% of ventricular area on parasagittal view)

Grade III: IVH (>50% of ventricular are on parasagittal view: usually distends lateral ventricle)

Grade IV: Periventricular echodensity (intraparanchymal hemorrhage)

Neonatal data collection included gender, birth weight, gestational age at delivery, mode of delivery, Apgar scores, age on admission, distance of transport, type of transport, use of surfactant and complications such as pneumothorax and respiratory distress syndrome (RDS).

Information gathered from maternal histories included prenatal complications, type of delivery and use of antenatal corticosteroids. Statistical analysis was performed with SPSS version 15 software.

T-test and chi-square test were used to compare the two groups. A p-value < 0.05 was regarded as statistically significant.

This study was approved by the ethics committee of the Shiraz University of Medical Sciences. All participants were completely informed about the details of this study and filled the informed consent form.

Results

There were 60 cases (37.3%) of IVH in the 161 newborns, 24 of 96 delivered at level III centers (25%) and 36 of 65 outborn neonates (55.4%). This difference was highly significant ($p< 0.001$) No significant difference was present between the two groups in terms of gestational age, birth weight, incidence of RDS, 5min-Apgar scores, pneumothorax and mortality rate (Table 1).

Of the 24 inborn neonates who had IVH in 62.5% (15) the hemorrhage occurred during the first day of life and in 87.5% (21) at the end of the first week.

In 36 outborn neonates who had IVH, in 77.7% (28) of the cases hemorrhage was detected during the first day of admission and in 94.3% (34) at the end of the first week.

Table 2 compares the degree of IVH between

Table -1. Characteristics and outcomes of outborn and inborn groups.

	Inborn	Outborn	P
Total	96	65	
Mean gestational age (w)	30.59±2.4	30.68±2.8	0.827
Mean birth weight (g)	1396±427	1445±486	0.507
5-min APGAR	8.3±1.7	8.6±1.5	0.346
Incidence of RDS	65(67.7%)	44(67.7%)	0.998
Incidence of pneumothorax	11 (11.5%)	11(16.9%)	0.322
Intraventricular hemorrhage	24 (25%)	36(55.4%)	<0.001
Mortality rate	22 (22.9%)	17(27.4%)	0.522

outborn and inborn neonates. In the first sonography we did not find a significant difference in the severity of hemorrhage between inborn and outborn groups (p= 0.055); but the rate of high grade IVH was significantly higher on the 7th and 30th days in outborn neonates versus inborn neonates (p= 0.02 on the 7th day and p= 0.035 on the 30th day). Mean gestational age and mean birth weight were significantly lower in neonates with IVH than neonates without IVH in inborn groups (p< 0.001 for GA and p< 0.001 for weight); but there were no significant differences in outborn groups (p= 0.206 for GA and p= 0.942 for weight). In outborn neonates, IVH was significantly higher in female versus male neonates (p= 0.046). There were no significant differences in the incidence of IVH between the infants transferred via ambulance versus those transferred by their parents (p= 0.542). There were no relations between the distance transport and IVH (p= 0.672). The mode of delivery, preterm premature rupture of membranes (PROM), premature labor pain (PLP), maternal hypertension (HTN), vaginal bleeding, multiple pregnancies and 5min - Apgar scores as possible etiologic factors in IVH were evaluated (Table 3).

There were significant difference in IVH between the inborn and outborn infants delivered by Cesarean section (p= 0.001). Respiratory complications associated with increased risk of IVH were RDS (p= 0.026) and pneumothorax (p= 0.006). IVH was significantly lower in premature infants treated with surfactant (p= 0.008).

The rate of IVH was significantly higher in transported neonates not treated with surfactant (Table 4) versus non-treated inborn infants (p> 0.001).

Discussion

Our data showed that the rate of IVH was higher in premature infants who were born in other centers and then transported to tertiary centers. Although many studies showed that transport of premature infants is associated with a much higher risk of IVH (4, 7-10), Bradley *et al* (11). did not find this difference. We did not find a significant difference in mortality rates between the two groups. Several other studies supported the same view. (10, 11) Shlossman *et al* (9). showed a significant difference in mortality rates between inborn and outborn groups (3). In our study the distance of transport did not have a significant effect in the rate of IVH in transported infants, unlike Mori et al who found a relation between them (12). In our study there was no difference in the rate of IVH between newborns transferred by ambulance and those transported by their parents. We attribute this finding to the better condition of infants transported by their parents or possibly to the substandard manner of transportation and insufficient monitoring.

Lui *et al* have shown that reducing non tertiary hospital births and optimizing transport of outborn infants to perinatal centers have improved the outcome of extremely premature infants considerably (13).

In our study IVH was significantly higher in the outborn versus inborn infants whose mothers did not receive antenatal corticosteroid therapy. In a study by Badiee maternal antenatal treatment with steroids was associated with lower incidences of IVH (14). When adjustment for antenatal steroids were added the effect of birth center was no longer significant (9).

This study suggests that in those cases without respiratory complications the incidence of IVH was significantly higher in outborn infants

Table- 2. grading of Intraventricular hemorrhage between outborn and inborn neonates

	Grade I	Grade II	Grade III	Grade IV	Post hemorrhagic ventricolomegaly	Total
Inborn neonates	8 (33.3%)	7(29.1%)	4(16.6%)	5(8.3%)	2(8.3%)	24
Outborn neonates	14(38.8%)	7(19.4%)	11(30.5%)	4(11.1%)	8(22.2%)	36

Table- 3. Antenatal and obstetric characteristics of newborns who developed intraventricular hemorrhage between inborn and outborn groups

	Total population	In born	Outborn	P
Cesarean section	35/101	15/66 (22.7%)	20/35 (57.1%)	0.001
NVD	17/33	5/13 (38.5%)	12/20 (60%)	0.226
PROM	14/49	6/35 (17.1%)	8/14 (57.1%)	0.005
Without PROM	46/110	18/59 (30.5%)	28/51 (54.9%)	0.01
PLP	18/57	9/37 (24.3%)	9/20 (45%)	0.109
Without PLP	42/102	15/57 (26.3%)	27/45 (60%)	0.001
Maternal HTN	12/31	6/21 (28.6%)	6/10 (60%)	0.093
without maternal HTN	48/129	18/74 (24.3%)	30/55 (54.5%)	0.001>
5-min APGAR <7	8/17	7/12 (58.3%)	1/5 (20%)	0.294
5-min APGAR ≥7	27/91	9/59 (15.3%)	18/32 (56.3%)	0.001>
Antenatal corticosteroid therapy	11/30	10/28 (35.7%)	1/2 (50%)	0.99
without Antenatal corticosteroid therapy	49/130	14/67 (20.9%)	35/63 (55.6%)	0.001>
single pregnancy	37/88	14/44 (31.8%)	23/44 (52.3%)	0.052
twin pregnancy	14/48	6/33 (18.2%)	8/15 (53.3%)	0.019
triple pregnancy	9/15	4/9 (44.4%)	5/6 (83.3%)	0.287
maternal vaginal bleeding	7/17	3/10 (30%)	4/7 (57.1%)	0.350
Without maternal vaginal bleeding	53/143	21/85 (24.7%)	32/58 (55.2%)	0.001>

Table- 4. Respiratory complications with IVH in inborn and outborn groups.

	Total	In born	Outborn	P
IVH in surfactant treated infants	34/70	19/44 (43.2%)	15/26 (57.7%)	0.241
IVH in non surfactant treated infants	25/89	5/51 (9.8%)	20/38 (52.6%)	0.001>
IVH in cases with RDS	47/109	22/65 (33.8%)	25/44 (56.8%)	0.018
IVH in cases without RDS	13/52	2/31 (6.5%)	11/21 (52.4%)	0.001>
IVH in cases with pneumothorax	14/22	7/11 (63.6%)	7/11 (63.6%)	0.99
IVH in cases without pneumothorax	46/139	17/85 (20%)	29/54 (53.7%)	0.001>

versus inborn infants; but the IVH rate was not significantly different.

Conclusion

The incidence of IVH is significantly higher in transported premature infants versus inborn infants. Our study suggests intrauterine transport of preterm infants reduces the incidence and severity of IVH. Prevention of prematurity, better prenatal care, antenatal corticosteroids and optimal management of respiratory problems are essential for prevention of IVH.

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References

1. Avery GB, Fletcher MA, MacDonald MG. Neonatology:Pathophysiology and management of the newborn, 5th ed. Philadelphia: Lippincott Williams and Wilkins; 1999. p. 151-152.
2. Holt J, Fagerli I. Air transport of the sick newborn infant: Audit from a sparsely populated county in Norway. Acta Paediatr 1999; 88: 66-71.
3. Shlossman PA, Manley JS, Sciscione AC, Colmorgen GHC. An analysis of neonatal morbidity and mortality in maternal (in utero) and neonatal transports at 24-34 weeks' gestation. Am j of perinatol 1997; 14: 449-56.
4. Towers CV, Bonebrake R, Padilla G, Rumney P. The effect of transport on the rate of severe intraventricular hemorrhage in very low birth weight infants. Obstet & Gynecol 2000; 95: 291.
5. Cohen RS, Stevenson DK, Malachowski N, Ariagno RL, Kimble KJ, Hopper AO, *et al*. Favorable results of neonatal intensive care for very low-birth-weight infants. Pediatrics 1982; 69: 621
6. Kollee LA, Verloove-Vanhorick PP, Verwey RA, Brand R, Ruys JH. Maternal and neonatal transport: results of a national collaborative survey of preterm and very low birth weight infants in The Netherlands. Obstet Gynecol 1988; 72: 729-732.
7. Volpe JJ. Neurology of the newborn. 3rd ed. Philadelphia: W.B. Saunders; 1995. p. 411-16.
8. Synnes AR, Chien LY, Peliowski A, Baboolal R, Lee SK. Variations in intraventricular hemorrhage incidence rates among Canadian neonatal intensive care units. The J of pediatr 2001; 138: 525-531.
9. Shlossman PA, Manley JS, Sciscione AC, Colmorgen GHC. An analysis of neonatal morbidity and mortality in maternal (in utero) and neonatal transports at 24-34 weeks' gestation. Am jo perinatol 1997; 14: 449-456.
10. Palmer KG, Kronsberg SS, Barton BA, Hobbs CA, Hall RW, Anand KJS. Effect of inborn versus outborn delivery on clinical outcomes in ventilated preterm neonates: secondary results from the NEOPAIN trial. Journal of Perinatology. 2004; 25: 270-275.
11. Yoder BA. Long distance perinatal transport. Am J Perinatology 1992; 9: 75-79.
12. Mori R, Fujimura M, Shiraishi J, Evans B, Corkett M, Negishi H, *et al*. Duration of inter-facility neonatal transport and neonatal mortality: Systematic review and cohort study. Pediatr Int 2007; 49: 452-458.
13. Lui K, Abdel-Latif ME, Allgood CL, Bajuk B, Oei J, Berry A, *et al*. Improved outcomes of extremely premature outborn infants: effects of strategic changes in perinatal and retrieval services. Pediatrics 2006; 118: 2076-2083.
14. Badiee Z. Intraventricular hemorrhage in very low birth weight infants. Associated risk factors in Isfahan, Iran. Saudi Med J 2007; 28:1362-1366.