PAPERS AND SHORT REPORTS

Effect of birthplace on infants with low birth weight

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Abstract

From December 1983 to June 1985, 162 infants of less than 32 weeks' gestation or weighing less than 1500 g, or both, were cared for at the regional neonatal intensive care unit in Leeds. Of the 162, 64 (40%) were born in the unit because their mothers had received antenatal care there, 58 (36%) were born in another hospital and subsequently transferred, and 40 (25%) were transferred in utero because of potential complications. The overall mortalities for each group were 14%, 38%, and 18% respectively. These differences were significant, but when they were corrected for gestation, birth weight, and mode of delivery there was no difference in either the mortality or the incidence of intraventricular haemorrhage in the three study populations.

Although there seem to be no distinct advantages of in utero transfer in terms of mortality and morbidity, there are other psychological and emotional advantages.

Introduction

A woman who presents in the early part of the third trimester with hypertension, premature rupture of the membranes, preterm labour, or other maternal disease often causes problems in management, particularly in hospitals that do not have facilities for neonatal intensive care. Some authors have reported that in utero transfer of the fetus helps to decrease perinatal mortality in this group of infants.^{1,2} Others have commented on the difficulties of such a policy,^{3,4} particularly as not all women in preterm labour go on to deliver infants who ultimately need intensive care.

We analysed the mortality and short term neurological outcome of 162 infants with very low birth weight who were either inborn, outborn, or transferred in utero to a large regional perinatal centre.

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Patients and methods

The regional neonatal intensive care unit in the Clarendon Wing, Leeds General Infirmary, admits over 500 patients a year. It serves a population that has 48 000 deliveries a year, and patients are admitted to the unit from Leeds and district general hospitals throughout the Yorkshire region and beyond. Many of the neonates admitted to the unit are transferred after delivery from district general hospitals at distances of 10 to 50 miles and travelling times of 20 to 90 minutes from the regional centre.

For the purpose of this study inborn patients were defined as liveborn babies whose mothers received antenatal care and who were delivered at the Clarendon Wing. Outborn deliveries were defined as liveborn infants who were born outside the Clarendon Wing and were subsequently transferred after birth for neonatal intensive care. In utero transfers were defined as liveborn infants whose mothers were booked at a district general hospital but were transferred for delivery to the Clarendon Wing because of maternal disease or possible fetal complications.

During the 18 months from December 1983 to June 1985 data were collected prospectively for all liveborn infants who were either at less than 32 weeks' gestation or who weighed less than 1500 g, or both. Obstetric data were collected from the maternal records at delivery or transfer, and neonatal data were collected from the patients' notes. Infants with lethal congenital malformations were excluded from the analysis. Mortality was defined as death occurring before discharge or referral back to the base hospital. All infants had regular cranial ultrasound scans, and any haemorrhages detected were graded according to the classification of Papile *et al.*⁵

Outcome variables were statistically analysed by covariance or logistic regression, as appropriate, to test for a significant difference between study populations while allowing for different distributions of gestation, birth weight, and mode of delivery. Apgar scores were analysed by an extension of the Hodges-Lehman test,⁶ which provides multiple comparisons of the study groups after adjusting for the effect of mode of delivery.

Results

During the study 162 infants of less than 32 weeks' gestation or weighing less than 1500 g, or both, were admitted to the regional intensive care unit in Leeds. Of these 40 were in utero transfers, 64 were inborn, and 58 were outborn. The main measures of outcome were taken as death or serious intraventricular haemorrhage (grade III or IV); secondary measures of outcome were Apgar scores at one and five minutes, minimum pH recorded, maximum fractional inspiratory oxygen required, and occurrence of respiratory distress syndrome (table I). The overall mortalities in the in utero transfer, inborn, and outborn groups were 14%, 38%, and 18% respectively; these differences were significant ($p=0.005$). The incidence of serious intraventricular haemorrhage was not significantly different among the three groups, being 13% for the in utero transfers, 14% for the inborn, and 19% for the outborn.

The three groups varied, however, in the distribution of birth weight, gestation, and mode of delivery (table II). When the study groups were again compared after adjusting for these factors there was no significant difference in mortality ($p=0.27$) or the occurrence of serious intraventricular haemorrhage ($p=0.66$) (table III). For the secondary measures there was no significant difference among the groups in the occurrence of respiratory distress syndrome ($p=0.15$), maximum fractional inspiratory oxygen required ($p=0.08$), or minimum pH recorded ($p=0.12$), but there was some indication that babies in the outborn group fared worse than the inborn and in utero transfer groups. There was a significant difference among the groups on both Apgar scores after adjusting for mode of delivery. No adjustment for birth weight or gestation was attempted as no correlation coefficient exceeded 0.2. For Apgar scores at one minute the median scores for the in utero transfer, inborn, and outborn groups were seven, six, and four respectively. Multiple comparison showed that the in utero transfer and inborn groups were both significantly different from the outborn group ($p<0.05$) but not from each other ($p>0.05$). The median Apgar scores at five minutes were nine, nine, and seven respectively, and, as before, the in utero transfer and inborn groups were both significantly different from the outborn group ($p<0.01$) but not from each other ($p>0.05$).

Other variables were collected during the study but were not analysed in any great depth. These included the obstetric factors present before delivery and extra information on ventilation and other complications after birth (table IV).

TABLE I—Main and secondary measures of outcome in 162 babies in study

	In utero transfer (n=40)	Inborn (n=64)	Outborn (n=58)
<i>Main measures of outcome</i>			
No (%) of babies who:			
Died	7 (18)	9 (14)	22 (38)
Suffered from serious intraventricular haemorrhage	5 (13)	9 (14)	11 (19)
<i>Secondary measures of outcome</i>			
No (%) of babies who suffered from respiratory distress syndrome	29 (73)	47 (74)	52 (90)
Median (range) Apgar score:			
At one minute	7 (1-9)	6 (0-10)	4 (1-9)
At five minutes	9 (5-10)	9 (1-10)	7 (3-9)
Median (range) maximum fractional inspiratory oxygen required	0.6 (0.2-1.0)	0.7 (0.2-1.0)	0.9 (0.2-1.0)
Median (range) minimum pH recorded	7.2 (6.6-7.5)	7.2 (6.7-7.4)	7.2 (6.6-7.3)

TABLE II—Distribution of birth weight and gestation, mode of delivery, and grades of intraventricular haemorrhage in study population (figures are numbers (percentages) of patients)

	In utero transfer (n=40)	Inborn (n=64)	Outborn (n=58)
Birth weight (g):			
<750		3 (5)	8 (14)
750-999	10 (25)	9 (14)	14 (24)
1000-1249	10 (25)	10 (16)	13 (22)
1250-1499	10 (25)	18 (28)	9 (16)
≥1500	10 (25)	24 (38)	14 (24)
Gestation (weeks):			
≤26	8 (20)	8 (13)	18 (31)
27-28	7 (18)	16 (25)	12 (21)
29-30	14 (35)	13 (20)	13 (22)
31-32	11 (27)	27 (42)	15 (26)
Mode of delivery:			
Spontaneous vertex	4 (10)	14 (22)	27 (47)
Forceps	6 (15)	10 (16)	2 (3)
Caesarean section	24 (60)	29 (45)	18 (31)
Breech	6 (15)	11 (17)	11 (19)

TABLE III—Number (%) of babies who suffered from intraventricular haemorrhage in study population

Grade of intraventricular haemorrhage	In utero transfer (n=40)	Inborn (n=64)	Outborn (n=58)
I	2 (5)	7 (11)	7 (12)
II		2 (3)	4 (7)
III	2 (5)	7 (11)	6 (10)
IV	3 (8)	2 (3)	5 (9)

TABLE IV—Obstetric factors present before delivery and measures of outcome after birth in study population (figures are numbers of patients, unless otherwise stated)

	In utero transfer (n=40)	Inborn (n=64)	Outborn (n=58)
<i>Obstetric factors present in mothers before delivery</i>			
Diabetes	1	1	
Pre-eclampsia	10	8	9
Prolonged rupture of membranes	7	15	3
Antepartum haemorrhage	5	19	14
Use before birth of:			
Tocolytics	5	6	5
Steroids	5	1	3
<i>Measures of outcome in infants after birth</i>			
Pneumothorax	5	9	13
Pulmonary interstitial emphysema	6	5	9
Patent ductus arteriosus	9	13	16
Use of fresh frozen plasma	22	30	29
Ventilated	27	47	52
Mean (SD) maximum PaCO ₂ (kPa)	7.5 (2.0) (n=33)	7.9 (2.5) (n=49)	8.0 (2.5) (n=53)
Mean (SD) maximum positive inspiratory pressure (cm H ₂ O)	26 (6) (n=27)	28 (8) (n=43)	28 (6) (n=52)

Discussion

Infants with very low birth weight who are born in a regional neonatal intensive care unit have an increased chance of survival compared with similar infants born in places without such facilities.⁷ Infants who are transferred after birth to a centre with facilities for intensive care also have a much better prognosis than if they were left at the referring hospital.⁹ On this basis a system of neonatal transfer has developed, and it is generally believed that antenatal transfer of the high risk infant further decreases perinatal mortality and morbidity.

We too had thought that antenatal transfer of our patients had improved their outcome; certainly the crude mortalities for the inborn, outborn, and in utero transfer groups suggested that infants transferred after birth had a higher mortality. Closer examination of our study populations, however, showed that the outborn babies were more immature and had a lower birth weight, and when these factors were taken into account there was no difference in the study populations. Our data concur with those of Modanlou *et al*, whose study reported that infants transferred in utero had a slightly higher (though not significantly) mortality than infants transferred after birth.¹⁰ More recently Lobb *et al* showed that for infants weighing less than 1500 g survival in those transferred in utero and those inborn was not significantly different but was significantly better than in infants transferred after birth or left at the referring hospital.¹¹

We were surprised that we did not find any difference in the incidence of intraventricular haemorrhage in the study populations, as our impression had been similar to that of Clark *et al*—namely, that outborn patients had a higher incidence of intraventricular haemorrhage. Although Clark *et al* showed that 53% of outborn patients developed intraventricular haemorrhage compared with 12% of inborn patients,¹² the incidence of serious intraventricular haemorrhage (grade III or IV) was similar in all our study groups. We have not followed up our patients for a sufficiently long period of time to determine whether the long term neurological outcome is any different for babies born at a high risk perinatal centre compared with those who are transferred after birth.

In a leader in the *British Medical Journal* Chiswick reminds us that: "a fresh look at antenatal transfer is needed before [the practice] spreads."¹³ In examining the advantages or otherwise of in utero transfer we were surprised that we did not find any striking benefits in terms of mortality or short term morbidity. The advantages of in utero transfer were subjective, resulting mostly from maternal confidence that everything possible was being done to help her and her unborn child and that delivery would take place where more comprehensively equipped obstetric and paediatric staff were available if needed. The mother and infant were also not separated by long distances. Conversely, the mother might be separated from

supportive relatives, and a happy transfer back to the referring hospital might be impeded because of her loss of confidence in it. A further disadvantage of in utero transfer was that much needed beds might be blocked by unnecessary referral, as in Manchester, where only 20% of antenatally transferred infants needed definitive ventilatory support.⁴ We, however, found that two thirds of our referrals required ventilatory assistance and did not encounter difficulties in accommodating mothers on our postnatal wards. Our subjective experience was that mothers appreciated being near their babies even though they often returned home before their baby was able to be discharged back to the referring hospital.

Patients who were transferred in utero in our study had better Apgar scores at both one and five minutes, and, as skilled resuscitation is so important for low birthweight babies, all high risk deliveries should take place where properly trained personnel and short term respiratory support are constantly available. The combined mortality in our inborn and in utero transfer groups was 15% compared with 30% in the rest of the Yorkshire region, thus emphasising the important benefits of the facilities that are available in large neonatal intensive care units.

Any study like this is confounded by the inherent differences among the study groups. The outborn infants transferred to us probably represented the more severely ill patients from the population, and their mortality cannot reasonably be compared with those not transferred. Similarly, the incidence of intraventricular haemorrhage in infants who are not transferred but remain in district general hospitals is unknown, and it is crucial that long term follow up studies are undertaken comparing infants transferred with those treated locally.

Although we have not shown a significant difference in mortality among our three populations, we believe that transfer in utero has definite emotional and psychological advantages that should not be disregarded. Although it is not easy to compare the cost of an in utero transfer with that undertaken by a neonatal flying squad, in

utero transfer does have the considerable advantage of not temporarily depleting regional neonatal units, which are invariably understaffed, of both nursing and medical personnel. We believe that paediatric and obstetric staff in district general hospitals, where facilities for intensive care are not immediately available, should liaise with their regional centre to determine the most appropriate action for each woman who presents with preterm labour.

We thank those paediatricians who referred babies to our unit, the nurses and junior doctors for expertly looking after them, and Mrs A Hartup for typing the manuscript.

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(Accepted 16 July 1986)

Effects of nutrient intake, surgery, sepsis, and long term administration of steroids on muscle function

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Abstract

The stimulated contraction-relaxation characteristics of the adductor pollicis muscle were used to assess nutritional state in patients and healthy controls. In both groups insufficient nutrition resulted in abnormal muscle function. The ratio of force of contraction at 10 Hz to that at 20 Hz yielded the best combination of sensitivity (87%) and specificity (82%). Sepsis resulted in abnormal muscle function, but the changes were easily distinguishable from those in subjects taking an inadequate diet. Long term administration of steroids, trauma, and surgery

had no effect on muscle function. A prospective study of 11 malnourished patients with abnormal muscle function showed that all variables of muscle function returned to normal values with total parenteral nutrition. This reversal correlated significantly with the duration of parenteral nutrition and occurred before any change in anthropometric variables or plasma albumin concentration.

Muscle function studies are sensitive and specific indicators of malnutrition; results depend on energy intake but are not influenced by administration of steroids, trauma, or surgery.

Introduction

Insufficient dietary intake results in malnutrition with wasting of muscle and alteration in the composition of the body.¹ Traditional assessments of malnutrition are based on anthropometry, hepatic protein synthesis, delayed cutaneous hypersensitivity, total body nitrogen content, and creatinine-height index.^{2,3} Changes in these objective measurements may be associated with non-nutritional factors such as malignancy, sepsis, and immobility^{4,5} and are no better than subjective clinical assessment in predicting complications of disease associated with nutrition.⁶ It has always been

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