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Maternal and Child Care: The Canadian Model

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A sophisticated regionalization plan in maternal and child care, including risk assessment, maternal transfer mechanisms, 24 hour communication availability, and regional tertiary perinatal intensive care units (high risk obstetrics integrated with level III neonatal intensive care), has allowed the Province of Ontario to significantly decrease perinatal mortality. Data collection by hospital of birth, birthweight and gestational age shows that this effect is most marked in the preterm infant between 25 and 32 weeks and in hospitals with small obstetrical volumes. Little decrease in incidence of preterm birth has occurred. Multiple births provide a significant number of the preterm births; singleton rates between 20-36 weeks are 5.48%, twins 42.97%, and triplets 95.3%. However, when compared with singletons of the same birthweight, the mortality rates for twins are less than those of singletons, and triplets are even less again. High incidence of prematurity in multiple pregnancies means that a regional perinatal unit has a large occurrence of maternally transferred high risk pregnancies. In our institute, a 10-year review between 1978 and 1988, showed an incidence of 24 triplet, four quadruplet, and one quintuplet pregnancies. Review of outcome and data relative to these pregnancies showed an early neonatal mortality rate of 31.6, a perinatal mortality rate of 51.5 and survival to discharge of 93%. The occurrence of neonatal complications was respiratory distress syndrome in 43%, bronchopulmonary dysplasia in 6%, and intraventricular hemorrhage in 4%. Long term follow-up showed only one severely handicapped child (mental retardation and cerebral palsy), 10 infants with a mild hypotonia and mild delay in gross motor development (both considered functional and transient), and 74% entirely normal. It is concluded that integrated perinatal care can result in excellent outcomes for multiple pregnancies as long as all components of antenatal, intrapartum, and neonatal care are combined effectively.

The Canadian Health Care System, while under the direction and aegis of the Federal Government, who pays for the Health Care System by transfer payments to the provinces, is in practice under the control and direction of the individual provinces. This is predominantly for geographical reasons due to the tremendous distances involved across the country itself. Thus, for practical purposes, the data and recording will be

predominantly on a provincial basis although the principals involved are the same throughout the country.

We have been very fortunate over the last number of years, through a combination of review by Provincial Government and the Ontario Medical Association of Maternal Mortality, to have achieved a relatively low maternal mortality rate. At the present time it runs usually between 4.2 in 1989 and 2.7 in 1990 direct maternal mortality rate per 100,000 livebirths [2]. Thus, since the mid-70s we have been able to concentrate on neonatal outcome, which was previously not nearly as successful, running in the neighbourhood of a perinatal mortality rate of about 20 per 1,000 livebirths.

The initial step was to delineate the infants who would be able to obtain major benefit from neonatal intensive care and thus, decrease neonatal mortality. It was felt that if one screened antenatally for risk, one could delineate about 100 out of every thousand pregnancies, which would put the neonate at risk for one reason or another; of these, only about 7 would actually require subsequent neonatal intensive care. It was disconcerting to note that approximately twice as many would require neonatal intensive care from pregnancies that had not been delineated as being at risk. This was, of course, because of the problem of prematurity, the majority of which is not always predictable. It was decided, therefore, that in Ontario we had to provide a standard of care at three different levels of sophistication according to the extent of risk involved for each individual neonate. To do this, we divided the province into six health care regions, originally with a Perinatal Committee for each region to aid in organization and coordination, and a designated tertiary resource for each health care region capable of providing level III neonatal intensive care. Initially, there was some debate as to the type of unit that should be provided, but data comparing isolated neonatal intensive care with combined perinatal intensive care having an integrated obstetric and neonatal intensive care unit very quickly showed that indeed there was a considerable difference in outcome in the latter type of unit; a far larger, intact survival rate occurring with integrated perinatal intensive care and lower handicap and death rates in all weight groups below 1500g. For this reason, the tertiary resources which would be required for the high risk neonates, ie. about 2-3% of the population, were developed as perinatal intensive care units. The level I units, which provided care for the great majority of mothers, had no additional equipment for neonatal intensive care. There was a group of 12% of pregnancies, approximately, needing level II facilities that would provide neonatal intensive care for infants above 34 weeks; and certainly below 32 weeks the level III neonatal intensive care units were the ones required. In addition, on a provincial basis, through the Ontario Medical Association initially, and subsequently by the Ministry of Health, we provided antenatal records which delineated risk scoring and indicated potential response to risk. These records are in three parts, one for the physician's office, one for the maternal hospital chart and one for the neonatal chart. This is now used on a voluntary basis by about 98% of the physicians in the province. Transfer facilities by land were also provided in the majority of cases, but helicopter and fixed wing transfer mechanisms were also available. Transfer guidelines were drawn up by the Ontario Medical Association and distributed to all physicians and hospitals in the Province. The Ministry of Health also ensured that data collection, by weight groups and individual hospitals for the province was made available, and much of the data presented on a provincial basis is from the Ministry of Health publications of their data collection [3,4]. The Ministry has also

provided an occupancy registry showing the availability of tertiary facilities and beds in all the tertiary resources throughout the province, so that a single phone call by a physician can not only delineate where a bed is available when required, but also transfer facilities can be arranged and instituted on the basis of the bed registry.

Since the introducion of this regionalized system of perinatal care, we have seen a significant drop in the perinatal mortality rate for singleton births, as shown in the Ministry data up to 1987. If one looks at a breakdown of where this improvement in perinatal mortality has occurred, it becomes readily apparent that the major part has been in the groups between 25 and 32 weeks'gestation. Some improvement is also to be seen in the 42 week and over pregnancies, probably due to an enhanced attempt at induction after documentation by ultrasound of gestational age. The mode of bringing about this reduction, especially in the low weight group, ie. 500g to 1500g, can be seen by comparing the mortality rates of infants born in tertiary facilities as opposed to the mortality rates of those born outside tertiary units. In all weight groups, there is a significant decline in the mortality rate of those born in the perinatal unit. The resulting mortality rates show that indeed over 500g we are now running at about 8 per 1.000 livebirths, and if we look at mortality rates over 1000g it is about 5.5. Interestingly, if one looks at the mortality rates of singletons alone and eliminates the effects of the multiple pregnancies, the rates are even lower running to about 5.27 over 1000g for singleton births in the province. It is also interesting to note that if one considers births in terms of hospital volume and compares the mortality rates in hospitals with less than 500 births per year, initially the rates were significantly higher than in the larger hospitals. However, with the introduction of the regionalized system, the mortality rate has dropped considerably more in the smaller hospitals than in the larger ones which, perhaps, experience more reluctance to key into the system as effectively as the smaller hospitals do. If one breaks down the perinatal mortality rate into stillbirths and neonatal deaths, one can see that while the overall perinatal mortality rate has dropped by about 25%, only about 21% of this is due to a drop in the stillbirth rate, despite our introduction of increased use of ultrasound and other evaluation tests such as the biophysical profile. The neonatal death rate has fallen considerably more, with a drop of about 30.8% over the same time frame. Unfortunately, we still seem to have a problem relating to the incidence of low birthweight infants. We see a small overall drop in the 500-1500g group, and a slightly larger drop in the 1500-2500g weight group. However, our overall incidence is still about 94.9% of term infants, thus, slightly over a 5% incidence of preterm births is still occurring. Obviously, this is an area where a major improvement must be made in the future.

One of the major problems relative to prematurity, of course, is its occurrence in multiple pregnancies. From 1979-1987, we found that the singleton birth rate between 20-36 weeks' gestation was about 5.4%, while in twins it was about 42.9%. In triplets the incidence of births at less than 36 weeks was 95% (Table 1) Thus, multiple pregnancies with their associated incidence of prematurity also cause an increased problem as regards mortality. Interestingly, however, if we compare mortality rates in the different weight groups for twins and triplets to those for singletons, we find that birthweight-specific mortality is less for twins and even less again for triplets when compared with singleton gestations in the same birthweight group (Table 2).

Our own health care region around the area of Metropolitan Toronto is a large one

Table 1 - Prematurity Rate (%) for singleton, twin and triplet births in Ontario in 1987 [4]

		Singletons	Twins	Triplets
	20–28 Wks	0.63%	5.65%	16.92%
	29–36 Wks	4.85%	37.32%	78.46%
TOTAL	20–36 Wks	5.48%	42.97%	95.38%

Table 2 - *Birthweight-specific perinatal mortality rates in Ontario for combined years 1979, 1981, 1983, 1985, 1987* [4]

Birthweight	Perinatal Mortality Rate per 1,000 Births		
	Singletons	Twins	Triplets
500–749	774.7	675.4	461.5
750–999	440.3	380.3	166.7
1000–1499	253.7	151.9	54.1
1500–2499	58.0	22.9	8.1
2500–4249	3.4	5.9	–

of approximately 60,000 livebirths per year. It extends about 30 miles west, 100 miles east, and 150 miles north of Metropolitan Toronto. The majority of our transfers, even in the winter time, can be overland although on occasion a helicopter is used. In our own tertiary facility at Women's College Hospital, we see a significant incidence of both twins and triplets, and this appears to be increasing as people become more acccomplished in the use of transfer facilities. About 45% of our twins, for example, are maternal transfers from other hospitals because of some complication which leads to the birth of premature infants. Most commonly these complications are premature rupture of the membranes, or premature labour. There is also about a 7% incidence of toxaemia, which accounts for such a transfer. One of the big advantages of the regionalized system, of course, is that it allows a large number of such problem pregnancies to be evaluated.

The collation of this subsequent material was coordinated by Ron Gonen, a Fellow of mine for two years, who, in conjunction with the neonatologists and staff in charge of our follow-up clinic, produced a great deal of the following data [1]. The definitions used are standard and include retinopathy of prematuriy by the international classification, bronchopulmonary dysplasia as delineated by still needing 30% oxygen ventilation after 30 days. Early neonatal death, late neonatal death and perinatal mortality rates are defined by international classification. This material has been produced in depth in the American Journal of Obstetrics and Gynaecology for those who are interested in more detail.

If we look initially, we find that about 50% of the multiple pregnancies were by ovulation induction methods of one type or another. The quintuplet pregnancy was by in vitro fertilization. In total about 73% of the patients were hospitalized by elective admis-

sion to provide the mother with enhanced bedrest and support. The remainder were emergency transfers from other hospitals because of some complication which would probably result in preterm delivery. The elective admissions, however, resulted in hospitalization for over 5 weeks in almost all cases; half of these patients received betamethazone and about one-third received tocolytic agents to suppress uterine activity at a time when we felt it might be more beneficial to prolong gestation somewhat further. A small number of mothers had additional complications, such as, pregnancy induced hypertension; about 17% had the usual complaints relative to dyspnea and hydramnios. The commonest complications resulting in delivery were spontaneous premature labour or premature rupture of the membranes. Therefore virtually all the pregnancies resulted in preterm delivery and about half of these were below 32 weeks gestation. All were delivered by caesarean section, except for one triplet pregnancy of 25 weeks gestation, which was delivered vaginally because of poor prognosis for intact survival. Four of the triplet pregnancies were monochorionic and, interestingly, two of these were associated with a stillbirth. The weights for the infants were good at time of birth, but there was about a 17% incidence of small for gestational age infants in the triplets. Four of the triplet infants were also associated with congenital anomalies; one was present in one of the stillbirths that occurred and it was major cardiac anomalies that were involved.

Overall, there was a 93% survival to discharge in the triplets and 90% in the quadruplet pregnancies. In the quadruplet pregnancies, two of the infants that died out of 20 were, in fact, late neonatal deaths. There were also two infant deaths in the triplet group, one of which was a SIDS death. Overall, the perinatal mortality of the entire group was 51.5 with a 93% survival to discharge (Table 3). Two of the triplet deaths were in the 25 week gestation pregnancy and there were two other deaths at 27 weeks, one in a quadruplet pregnancy following the complication of necrotizing enterocolitis, and one in a triplet pregnancy where the infant weighed 870g and died at 130 days of age as a result of persistant pulmonary problems. Five of the respiratory distress syndrome (RDS) deaths occurred early in the series, ie. in the early 80s prior to the use in our unit of artificial bovine surfactant. This has now been in use since 1984. The majority of the infants required some degree of assisted ventilation at birth, but in most cases, the infants were off ventilation by about $32^{1}/_{2}$ weeks gestation overall. Other complications (Table 4), for the most part, were mild, with about a 21% incidence of persistent ductus arteriosis, a 4% incidence of IVH, (two of these occurred in the infants at 25 weeks' gestation), about a 6% incidence of bronchopulmonary dysplasia, and three in-

Table 3 - Vital Statistics *(per 1000, ≥500 g)

	Triplets n=72	Quadruplets n=20	Quintuplets n=5	Total n=97
Stillbirths	2 (27.8)	0	0	2 (20.6)
Early NND	3 (42.9)	0	0	3 (31.6)
Perinatal Mortality	5 (69.4)	0	0	5 (51.5)
Survival to discharge	93	90	100	92.6

* Modified from Gonen et al [1]

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Table 4 - Neonatal outcome and complications*

	Triplets n=70	Quadruplets n=20	Quintuplets n=5	All n=95
Birthweight (gms)	1582±440	1172±229	983±124	
SGA	12(17%)	3 (15%)	–	15 (16%)
Congenital Anomalies	4 (6%)	–	–	4 (4%)
RDS	29 (41%)	11 (55%)	1	41 (43%)
BP Dysplasia	3 (4%)	3 (15%)		6 (6%)
Days Ventilated	11 ± 19	26 ± 22	27 ± 8	
P Ductus Arteriosus	9 (13%)	11 (55%)	–	20 (21%)
IVH	2/48 (4%)	1/18	0	3/71 (4%)

* Modified from Gonen et al [1]

fants had retinitis of prematurity, one of which was considered severe, the other two quite mild. Of the infants discharged, 55 were sent home, and 33 to level II hospitals closer to home to make it easier for the parents to visit. On long term follow-up, it was possibile to follow 84 of the 88 infants; one set of triplets was lost to follow-up as the patient moved outside of the country and one infant who had Down's syndrome was excluded from follow-up data. Of the 84 infants, 79% were followed from 18 months to 10 years, and 18 from less than 18 months at the time of evaluation. Ninety-five percent of the infants are normal as far as growth assessment is concerned, with only 5 infants being under the 5th percentile weight group for their age. One of these infants is also short. As far as neurological assessment in concerned, 86% of these infants are normal; only 10 infants are showing what is thought to be a mild hypotonia. One infant has a mild spastic diplegia. The infants with mild hypotonia are all aged from about a year to 15 months, and the condition is thought to be transitory. There is only one infant, again the 25 week surviving triplet, who has a moderately severe hypotonia and spastic diplegia. Developmental assessment also shows that 76% of these infants are entirely normal. Of the group of 10 with mild hypotonia, there is also an associated mild motor delay and mild language delay in 7. Only one infant has gross motor and social adaptive and language delays. This again is the triplet of 25 weeks who also has cerebral palsy.

The very significant perinatal mortality rate recorded by other authors in the English literature over the past 10 years caused us great concern and this was a major reason for the present review. These authors all show perinatal mortality rates over 150 and many of them over 200. This is compared with the present data which show the early neonatal mortality rate at 31 and a perinatal mortality rate of 51.5 and, as mentioned before, survival to discharge of 93%.

We feel that these data provide a far more optimistic picture for the outcome of multifetal gestation than has hitherto been reported in the literature. This is especially so when one considers that out of 84 infants 75% or more are normal, 22% show only a mild functional handicap and only 1 a severe handicap.

The major determinant is probably early diagnosis, thus permitting meticulous ante-

natal care to be provided, including early hospitalization and support for the mother. One must, of course, make a comprehensive assessment of fetal wellbeing, especially looking out for intrauterine growth retardation and a subsequent potential for stillbirth. We certainly feel that delivery by caesarean section with the attendance of a neonatologist and team for each baby plays a major role in subsequent neonatal wellbeing. Of course, one must have a highly functional NICU and associated team to continue with the care of these infants and the sophisticated technology that is required must be kept up-to-date at all times. In conclusion, if one has these, the outcome can be extremely positive for all concerned, not least the parents and the infants.

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