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The Role of Intrapartum Intravenous Therapy and Newborn Weight Loss: Challenging the 7% Rule

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Introduction

Caregivers monitor each newborn infant's weight following birth to determine whether nutritional supplements are required in addition to breastfeeding. Some degree of weight loss is typical in the first few days. A 5-7% weight loss is physiologically normal as the neonate adjusts to life outside the womb. A weight loss of 10% or greater is generally cause for concern and merits further medical evaluation [1]. Infants are given breast milk substitutes in the hospital shortly following birth for various reasons, including significant dehydration, hypoglycemia, maternal illness, medications that are contraindicated in breastfeeding, congenital deformation of the infant, delayed lactogenesis, hyperbilirubinemia, or if they have lost greater than approximately 7 to 10 percent of their body weight since birth [2-7]. While in some cases supplementation is necessary, the practice of supplementation based on weight loss alone, with no other criteria can result in undermining the mother's confidence in her ability to breastfeed [4]. Although guidelines have been written based on a rule of thumb with respect to newborn weight loss at or in excess of 7% as being clinically significant [8], there is little agreement in the scientific literature to support the widespread use of this protocol. Several North American studies have shown variances in reported weight loss. DeMarzo and colleagues reported a weight loss of up to 14.3% by day five, and that the weight loss exceeded 7% in nearly one in ten infants they examined [8]. Further studies reported that eight percent of breastfed infants lost at least 10% of their initial birth weight, with the maximal weight loss occurring by day three post-birth [9,10]. Dewey et al. (2003) found that 12% of breastfeeding infants had excessive weight loss, and that approximately half the infants lost in excess of 5% of their birth weight [10]. Two studies based in the United Kingdom showed significantly less weight loss than those reported in North America. One stated that average weight loss was 4-7% of birth weight, but acknowledged that there is limited normative data on neonatal weight loss [7]. A large study of 937 infants, including all methods of delivery, and both breast and formula fed infants reported infant weight at birth and again before discharge at 48 hours. They concluded that the median weight loss for all infants was 5.9% [11].

Evidence as to the factors that contribute to excess weight loss in newborn infants is a multifaceted phenomenon. Fluid overload is one clinical factor that not only affects the mother, but the newborn infant as well. A newborn may appear bloated when the mother receives excess intravenous fluid, the proposed contributor to newborn weight loss [12]. Interest in the association between intrapartum intravenous fluid administration and newborn weight loss has given rise to several studies. Martens and Romphf examined factors associated with newborn weight loss and concluded that epidural use was a contributor. Other factors included the infant's sex, length of hospital stay, and initial birth weight. Epidural use may play a role in delayed infant suckling, which could explain the weight loss. Moreover, intravenous preloading has become routine in administering regional analgesia in order to counter maternal hypotension. The intravenous fluids used during labor may be associated with neonatal weight loss [1]. These results support the opinion that a greater weight loss may be the result of the mother receiving intrapartum intravenous therapy. There has been a moderate amount of research that specifically examines the influence of intravenous therapy during labour and newborn weight loss and therefore forms the primary objective of this study.

Method

Study Design and Participants

This study incorporated a cross sectional design in which 137 mother/baby charts were initially examined for consideration. Exclusion criteria included multiple births, delivery complications in the mother or the infant, intravenous insertion in the infant, admission to neonatal intensive care, nasogastic feeds, malformations in the infant such as cleft lip or palate, or prematurity of less than 36 weeks. Infant birth weight was measured at birth and every 24 hours thereafter until discharge.

Data Collection

A final sample of 100 mother/baby dyads, delivered at Hamilton Health Sciences, McMaster University Medical Centre site in Hamilton, Ontario Canada, were systematically examined to develop a database in October, 2008 for secondary analyses. This study received human research approval from both Brock University and McMaster University Research Ethics Boards.

Data Analyses

We categorized relative weight loss in our sample to examine differences in delivery characteristics. We chose newborn weight loss with a cut-off of ≥ 7% as our dependent variable. Descriptive statistics using independent t-test analysis examined differences in weight loss using the 7% rule in newborn delivery characteristics including gravida, labour duration, intravenous volume and duration, birth weight, absolute and relative weight loss. Chi-square analysis determined differences in intrapartum characteristics relative to the 7% rule. Binary logistic regression analysis was used to examine the primary objective of the study. Specifically, we examined the predictable influence of intrapartum intravenous therapy volume on the risk of newborn weight loss in excess of ≥ 7%. The level of statistical significance was set at α=0.05. All statistical analyses were performed using SPSS, Version 22 (IBM Corporation, 2010) [13].

Results

This cross sectional design incorporated secondary data analysis examining the role of intrapartum intravenous therapy and method of delivery on newborn weight loss in an attempt to examine the 7% rule. A systematic random sample of 100 newborns, including 53 males and 47 females served as the subject base for this study. The prevalence of excessive newborn weight loss>7% relative body weight within the first 72 hours postpartum was 46%.

We categorized relative weight loss in our sample to examine differences in delivery characteristics (Table 1).

Variables		Weight Loss<7% (N=54)	Weight Loss>7% (N=46)
Newborn gender	Male	32 (59.3%)	21 (45.7%)
	Female	22 (40.7%)	25 (54.3%)
Delivery method	Vaginal	42 (77.8%)	22 (47.8%)
	Assisted vaginal	2 (3.7%)[a]	1 (2.2%)[a]
	Emergency C-section	5 (9.3%)	14 (30.4%)
	Planned C-section	5 (9.3%)	9 (19.6%)
Epidural †	Yes	41 (75.9%)	43 (93.5%)
	No	13 (24.1%)	3 (6.5%)[a]
Induction	Yes	19 (35/2%)	18 (39.1%)
	No	35 (64.8%)	28 (60.8%)
Delivery attendant	OB/GYN	45 (83.3%)	41 (89.1%)
	Midwife	6 (11.1%)	5 (10.9%)
	Resident	3 (5.6%)[a]	0 [a]
Intravenous therapy*	Yes	44 (81.5%)	44 (95.7%)
	No	10 (18.5%)	2 (4.3%)[a]
Feeding method	Breastfed	37 (69.8%)	34 (73.9%)
	Breastfed and formula	9 (17.0%)	9 (19.6%)
	Formula	7 (13.2%)[a]	3 (6.5%)[a]

*p<0.05, †p<0.01, [a]Cell count<5 subjects

Table 1: Intrapartum descriptive analysis by newborn weight loss

Chi-square analysis identified significant differences between weight loss groups and method of delivery (p<0.01), epidural use (p<0.01), and intravenous use (p<0.05). There were a greater number of vaginal deliveries for newborn infants that exhibited a weight loss<7%, while more emergency and planned caesarean sections were performed in the delivery of newborn infants with weight loss ≥ 7%. Further, a significantly greater number of mothers that delivered newborn infants with a weight loss ≥ 7% did not receive an epidural or intrapartum intravenous therapy. Newborn gender, labour induction, delivery attendant, and feeding method were not significantly different between infant weight loss groups (p>0.05).

Table 2 presents the newborn delivery characteristics by infant weight loss and for the entire sample.

Variables	Entire Sample (N=100)	Weight Loss <7% (N=54)	Weight Loss >7% (N=46)
Gravida (#)	2.46 ± 1.51	2.46 ± 1.31	2.46 ± 1.73
Labour duration (min)	510 ± 318	463 ± 285	572 ± 352
†Intravenous volume (ml)	2054 ± 1269	1744 ± 1236	2417 ± 1222
Intravenous duration (min)	373 ± 292	324 ± 277	432 ± 302
Birth weight (g)	3478 ± 462	3426 ± 416	3540 ± 508
†Absolute weight loss (g)	235.9 ± 101.9	166.1 ± 64.3	317.8 ± 72.6
†Relative weight loss (%)	6.67 ± 2.61	4.73 ± 1.68	8.95 ± 1.35
†p<0.01			

Table 2: Newborn delivery characteristics by weight loss (mean ± SD)

Independent t-test analysis indicated significantly less intravenous infusion volume in the mothers of newborns with <7% weight loss (p<0.01). While a trend was observed, no significant difference was found in the duration of intravenous therapy between newborn weight loss groups (p=0.06). The initial birth weight was comparable in both newborn groups (p>0.05). However, absolute and relative weight losses were significantly different between the two groups (p<0.01). The duration of labour and gravida were not significantly different between newborn weight loss groups.

The objective of this study was to determine if intravenous therapy before and during labour increased the risk of newborn weight loss. Binary logistic regression analysis indicated that increased intrapartum intravenous therapy significantly (p<0.013) increased the risk of newborn infant relative weight loss of ≥ 7%. Intrapartum intravenous therapy was found to explain 11% of newborn weight loss variance.

Discussion

During parturition, intravenous fluid is commonly administered to mothers for several reasons including, but not limited to, maintaining maternal hemodynamics, [14] reducing hypotension in the mother following epidurals and intrathecal anaesthesia for caesarian sections [15,16]. However, a woman in labour will already have had an increased intravascular and extravascular volume, while the administration of intravenous fluids increases the risk of fluid overload. Nevertheless, greater concern exists with regards to the risk of maternal dehydration than that of over-hydration.

Newborn weight loss is a phenomena that is only moderately understood. Early supplementation is one such practice that is undertaken when the relative weight loss of a newborn infant is ≥7% of their birth weight. Therefore, it is important to have a thorough understanding of what factors contribute to the weight loss in the newborn, and to gain a better understanding of those factors that might result in significant clinical weight loss of newborn body weight. We determined that intravenous therapy volume increased the risk of weight loss in a newborn infant. The current study identified nearly half (46%) of the newborn infants experienced weight loss ≥ 7% of their birth weight. This proportion was higher than that reported in

European studies [7,8]. It should be noted that if the weight loss cut-off had been set to ≥ 5% instead of ≥ 7% as has been reported in several previous studies, then 74% of the infants in our study would have been classified as having had excess weight loss compared to approximately half of the newborn infants in these studies. In the United Kingdom, intravenous therapy is not routinely used for vaginal deliveries, and is used only sparingly in operative deliveries [8]. The majority of pregnant women admitted to hospital received intravenous therapy prior to delivery. Intravenous therapy was received by 81.5% of women whose infants had a <7% weight loss, and by 95.7% of women whose infants had a ≥ 7% weight loss. Specifically, mothers of infants that lost ≥ 7% body weight received significantly more intravenously-infused normal saline fluid compared to mothers of infants with a weight loss of <7%. In addition, the volume infused was significantly correlated with an infant's post-birth weight loss. These findings suggest the greater volume of intravenous therapy infused to the mother increases the potential for the newborn infant to lose excess weight following delivery as a result of a fluid shift from the mother to the infant during the intrapartum period. A study by Chantry and colleagues observed the effects of intrapartum fluid shift from mother to unborn infant. They concluded that intrapartum fluid balance was a significant predictor of excess weight loss in newborn infants. The risk of weight loss increased when intravenous fluid administered in excess of 200 ml and at a rate of 100-200 ml/hour. This study suggests that intravenous fluids provided to the mother contributed to an increase in infant fluid volumes prior to birth and loss of extra fluid after birth [17]. Similarly, a randomized control trial evaluated the effect of a conservative volume (<500 ml at 75-100 ml/hour) of intrapartum intravenous fluids on weight loss in breastfed infants compared to the usual volume (≥ 500 ml at >125 ml/hour) routinely administered to pregnant women prior to delivery. The study found that conservative intrapartum intravenous fluid management, compared to the usual care, showed no difference in newborn weight loss in excess of 7%. However, the study also suggested that intrapartum volumes administered >2500 ml could be associated with increased newborn weight loss [13]. While there was no significant difference in the duration of the intravenous infusion, the observed trend in our study suggests that intravenous therapy flow rate, and the duration of intravenous therapy, warrants further examination.

Current clinical practice guidelines and discharge criteria suggest supplementation with formula for exclusively breastfed infants who exhibit an excess weight loss [18-20]. If this practice were modified, there may be significant benefits for the mother, baby, and the hospital. If the infant is not supplemented, the mother's confidence in her ability to successfully breastfeed is increased, which has in turn been previously shown to increase breastfeeding durations [2-5]. In addition, if the weight loss is limited to <7% body weight, then there will be less risk of the infant developing hypernatremic dehydration and sub-optimal breastfeeding behaviors [20,21]. Finally, if the amount of intravenous therapy infused is limited to a lesser amount, the infants would be expected to lose less body weight, which in turn would presumably impact hospital budgets with respect to decreased requirement for intravenous fluid, less formula used as infants will not be supplemented on account of excess weight loss, fewer required lab tests and a reduction in the re-admission rate for infants with excess weight loss. This is especially important in a time of fiscal constraints in the hospital sector and in the interest of ensuring a positive patient experience, together with the potential for enhanced health outcomes both physically for the baby and psychologically for the mother.

Our study revealed a significant difference in the method of delivery between the weight loss groups. Vaginal deliveries accounted for a greater proportion of the infants in the <7% weight loss group, while both scheduled and emergent caesarian deliveries accounted for a larger proportion of the infants losing ≥ 7% of body weight. During vaginal births there are less medical interventions, specifically epidural or spinal anesthesias, which result in an increased volume of intravenous therapy being infused at the time of the birth. In our study, 75.9% of those in the <7% body weight loss group had an epidural, compared with 93.5% of those in the ≥ 7% group. This finding was significant, and is important to note since the administration of anesthesia concurrently with intravenous therapy is a combination that poses a significant risk for excess body weight loss, and therefore should be closely monitored. However, it must be acknowledged that specific conditions that may have led to the decision to use a particular delivery method may have also impact weight loss.

A few limitations should be recognized in this study. First, the results of this study lack external validity in that the study was conducted in a tertiary hospital-based facility, and was limited to a restricted number of practitioners. It may be challenging to generalize the results beyond the environment in which the data were collected. Second, a sizable number of deliveries by midwives were lost due to same day discharges and a lack of follow-up assessment of infant body weights were observed. As a result, data from births involving midwives are not well represented in our sample. This is important considering method of delivery was a significant predictor of newborn weight loss. Third, other factors that would contribute to the weight loss in newborn infants such as gestational age and type of intravenous fluid were not considered. Finally, the cross-sectional design implemented in our study would prohibit any attempt at establishing a causal relationship or fundamental inferences between intravenous fluid volume and relative weight loss in newborn infants.

In conclusion, a significant relationship exists between the volume of intravenous therapy infused, and weight loss in a newborn. The utility of this finding is significant in that the infusion of intravenous therapy at the time of delivery is a controllable action. Therefore, policies should be reviewed regarding the use of intravenous therapy, taking into account the issues of the potential significant impacts for the mother, the newborn, and the hospital.

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