

## A Randomized Trial of Increased Intravenous Hydration in Labor When Oral Fluid Is Unrestricted

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**Background and Objectives:** Increased intravenous (IV) hydration is associated with decreased labor duration and oxytocin augmentation in nulliparous women when oral fluid is restricted. The objective of this study was to determine the effect of increased IV hydration on the duration of labor when access to oral fluid was unrestricted. **Methods:** Term, nulliparous women with uncomplicated singleton pregnancies were randomly assigned to receive lactated ringers at 250 ml per hour (IV fluid group) throughout active labor or usual care. All women were allowed unrestricted access to oral fluids. **Results:** Eighty women completed the study, 37 in the IV fluid group and 43 in the usual care group. There was no difference in the primary outcome of total duration of labor (9.5 versus 9.4 hours) or in the secondary outcomes of duration of the first stage (7.9 versus 8.0 hours), duration of second stage (1.6 versus 1.4 hours), or rate of oxytocin augmentation (51% versus 44%). **Conclusions:** Increased IV hydration does not decrease labor duration in nulliparous women when access to oral fluid is unrestricted.

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Sports medicine literature indicates that adequate hydration is useful for peak athletic performance.<sup>1,2</sup> Labor and birth can be viewed as a physical endurance event. It is logical, therefore, that adequate hydration contributes to an effective labor. Indeed, a well-known midwifery educator states, "The maintenance of hydration throughout labor is essential for the woman's well-being."<sup>3</sup> Optimal hydration for labor has never been defined, and little research exists to guide provider choice in this area.

Recent studies, involving almost 500 women, have demonstrated that increased intravenous (IV) fluids at a rate of 250 ml/hour in nulliparous women reduced the incidence of prolonged labors.<sup>4,5</sup> The larger of these studies also showed the duration of labor was significantly shorter, and oxytocin augmentation of labor was less frequent.<sup>5</sup> Each of these studies restricted laboring women to "Nil per Os" as is done on most labor and

delivery units due to concerns of aspiration if unanticipated general anesthetic is required. IV fluids are often administered at a maintenance rate of 125 ml/hour. With improved anesthesia technique, however, aspiration complications have become too rare to study,<sup>6</sup> and some providers feel restricting clear liquids for laboring women is unjustified.<sup>7</sup>

If the risk of aspiration is not significant, then the question of whether oral fluids can achieve optimal hydration in labor becomes relevant. Perhaps studies showing the benefits of increased IV fluids are merely showing that a maintenance rate of 125 ml/hour is not optimal. Arguably, if women are encouraged to drink to satisfy thirst, they may consume more than the oral equivalent of 125 ml/hour of IV fluid.

The present study sought to further elucidate the effect of increased IV hydration on labor outcomes in nulliparous women allowed to drink freely. If women can drink adequately to assure an unprolonged and un-augmented labor, then the question of the correct IV rate becomes moot. This topic is particularly relevant since the majority of laboring women in the United States require IV fluids for epidural analgesia. The primary objective of this study was to determine whether giving nulliparous laboring women higher rates of IV fluid

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still reduced labor duration when oral fluid intake was unrestricted.

## Methods

### Participant Recruitment

A prospective, randomized study was conducted at the Lancaster General Hospital in Lancaster, Pa. Recruitment of some participants occurred at prenatal visits of women attending a family medicine residency program ambulatory office. Participants were also recruited from three private obstetrical practices (obstetricians and midwives) during childbirth education classes. Recruitment period was between November 2003 and March 2005. The protocol was approved by the institutional review board of the hospital. All patients signed informed consent forms at the time of recruitment.

### Eligibility

Only nulliparous patients in spontaneous active labor with a singleton, vertex presentation  $\geq 37$  weeks gestation were included. Patients were eligible for inclusion if dilatation was between 2 and 5 cm, with or without ruptured membranes. Previously recruited and consented patients were excluded if electively scheduled for labor induction or cesarean section. Previously recruited and consented patients were also excluded at the time of admission if diagnosed with preeclampsia, chorioamnionitis, pyelonephritis, or maternal cardiac/renal disease. Amniotomy, epidural anesthesia, narcotic analgesia, oxytocin augmentation, and other labor management decisions were at the discretion of the attending provider. Before epidural anesthesia, patients were given boluses of IV fluid at the discretion of the anesthesiologist. Anesthesiology was unaware of randomization assignment.

### Group Assignments

Patients were randomly assigned to one of two groups when presenting in labor. Randomization was carried out at the obstetrical triage unit through use of a random number chart and consecutively numbered opaque sealed envelopes. One group received 250 ml of lactated Ringer's solution IV per hour (IV fluid group) and the other group received usual care. Usual care consisted of lactated Ringer's solution IV for medical indications at the discretion of the provider.

Women in both groups were allowed unrestricted access to oral fluids of their choice (water, juice, or carbonated soft drinks). Fluids were provided in a graduated, one-liter container, and nursing staff recorded volumes in four-ounce increments on a standardized data collection instrument. IV fluid volume was controlled by infusion pumps for all participants and recorded accurately on the same instrument.

### Data Analysis

Main outcome data (duration of labor, oxytocin augmentation, and IV and oral fluid volume) were recorded prospectively by nursing staff on the standardized instrument. A projected sample size of 40 patients in each group was determined on the basis of an ability to have an 80% likelihood of demonstrating a shortening of the total duration of labor by 25% from 9.5 hours to 7.1 hours based on previous data on mean labor times from the residency program maternity service. An effect size of 25% was used because it was anticipated that the difference in IV fluid volumes (and thus hydration status) between study groups would be larger than in previous trials, given the absence of routine IV fluid administration in the usual care group. The probability of detecting a type I error was 5% ( $\alpha=0.05$ ).

For comparisons of the duration of labor between the two groups, the onset of labor was defined by the time of admission. Statistical comparison between the two groups for differences between means was by *t* test, and comparison of proportions was by chi-square test or Fisher's exact test if less than five observations per cell. A difference between the two groups of  $P<0.008$  (Bonferroni adjustment for six outcomes) was defined as statistically significant. STATA, version 9.2, was used for all analyses.

## Results

A total of 220 women were recruited for the study; 116 did not meet eligibility criteria primarily due to scheduled induction but also for preterm delivery, preeclampsia, or scheduled cesarean section. Eleven women were delayed in triage due to bed shortages resulting in concomitant delays in fluid administration. Four women did not have consent forms available at the time of admission. Nine women delivered at another hospital or were lost to follow-up.

The remaining 80 patients met inclusion criteria and were randomized: 37 in the IV fluid group and 43 in the usual care group. Table 1 compares patient characteristics between the two groups. Women in the usual care group were slightly younger but otherwise key variables known to affect labor outcomes, such as cervical dilation, station, and epidural use were balanced between the groups.

The IV fluid group received more IV fluid compared to the usual care group (2,660 ml versus 1,627 ml). Oral fluid intakes were similar between the groups (790 ml versus 721 ml).

As shown in Table 2, for women delivered vaginally, the overall length, as well the length of the individual stages of labor, was similar between groups. There was also no group difference in the percentage of women delivered vaginally that had labor lasting more than 12 hours. Rates of labor augmentation with oxytocin and

Table 1  
Comparison of Characteristics Between Groups

Characteristic	Usual Care (n=43)	IV Fluid (n=37)
Maternal age (years)	20.5±4.3	22.7±4.3
Gestational age (weeks)	39.1±1.2	39.4±1.1
Race/ethnicity (%)		
White	51 (42–60)	68 (59–77)
Other	49 (40–58)	32 (23–41)
Insurance (%)		
Private	14 (8–20)	32 (23–41)
Medicaid	86 (80–92)	68 (59–77)
Dilatation at randomization (cm)	3.4±1.1	3.4±.91
Effacement at randomization (mean percentage)	78±20	82±19
Station at randomization	-1.3±1.0	-1.2±.9
Rupture of membranes before randomization (%)	37 (28–45)	46 (36–56)
Amniotomy (%)	49 (39–58)	39 (29–48)
Dilatation at rupture of membranes (cm)	4.8±3.0	4.1±2.6
Epidural (%)	76 (68–84)	86 (80–93)
Dilatation at epidural (cm)	5.3±2.7	5.2±2.0
Station at epidural	-0.69±.97	-0.52±1.16
Birth weight (g)	3,250±398	3,405±418
Baby's gender (%)		
Male	60 (52–69)	65 (56–74)
Female	40 (31–48)	35 (26–44)

Continuous variables displayed as mean ± standard deviation. Percentages are displayed with interquartile range.

method of delivery also failed to demonstrate a difference between groups.

Rates of maternal and neonatal complications were similar between the two groups. There were two cases of chorioamnionitis in the IV fluid group and none in the usual care group. There were no wound infections, postpartum hemorrhages, or cases of pulmonary edema before hospital discharge in either group. In the IV fluid group no babies had low 1-minute Apgar scores (<5) or low 5-minute Apgar scores (<7); in the usual care group, one baby had low 1-minute Apgar score and none had a low 5-minute Apgar score. Four babies from the IV fluid group and three from the usual care group were admitted to the neonatal intensive care unit. All babies were discharged alive.

## Discussion

Despite receiving more than 1,000 ml more of IV lactated Ringer's and a similar volume of oral fluid, women in the IV fluid group did not have shorter labors or a lower frequency of oxytocin augmentation compared to women undergoing usual care, consisting of IV fluid at provider discretion and unlimited oral intake. As a

result, we believe that when women are allowed to drink freely, higher rates of IV fluid are not required to maintain optimal hydration for the progression of labor.

Adequate hydration does seem to be an important factor for optimal labor progression. Since uterine blood flow is not autoregulated,<sup>8</sup> insensible losses during labor can cause a decrease in blood volume and a subsequent decrease in uterine blood flow. Traditionally, women receive intravenous hydration to replace these losses at 125 ml/hr, a rate that was originally calculated for patients at rest. Recent trials using IV lactated Ringer's solution at a rate of 250 ml/hr have shown outcomes associated with a shorter duration of labor, suggesting that increased hydration may improve uterine function. In one study of 195 women in California, the frequency of labor lasting more than 12 hours was less in a group of nulliparous women receiving 250 ml/hr than in a group receiving 125 ml/hr.<sup>4</sup> The average length of labor in our study was more than 500 minutes. Another study of 300 women, performed in Iran, showed a significantly shorter duration of labor in a 250 ml/hr treatment group compared to a 125 ml/hr group (253 versus 386 minutes), as well as a lower frequency of oxytocin administration (8% versus 20%).<sup>5</sup> Of note, women in this study did

not have the option of epidural anesthesia. Women were not allowed to drink (except ice chips in the first study) in either trial.

Our study sought to further clarify the importance of maternal hydration in labor. Similar to the other studies, our treatment group received IV lactated Ringer's solution at 250 ml/hr while the comparison group received usual care that only included IV fluid at a rate based on provider discretion. Both groups had unlimited access to oral fluids. We believe the most plausible explanation for the discrepant results between our study and these prior trials is that women allowed to drink freely self-regulate their volume status and can maintain adequate hydration as well as women receiving 250 ml/hr of IV fluid, rendering higher rates of IV fluids unnecessary. Self-regulating intake has important emotional benefits for laboring women; it has been shown to decrease stress while providing a feeling of control.<sup>9,10</sup> While the administration of IV fluids at 250 ml/hr did not cause any complications in this or prior studies, there is at least a theoretical risk of fluid overload in both mother and baby. The attendant complications of excessive amounts of fluid include pulmonary edema

and hyponatremia in the mother and decreased umbilical artery pH and transient respiratory distress in the newborn.<sup>11-13</sup>

If the administration of IV fluids at an increased rate is not superior to the usual rate with supplemental oral fluids, it is important to examine the safety of oral fluids in labor. Restrictions on oral intake during labor differ among institutions, ranging from total restriction to unlimited clear liquids.<sup>14</sup> The advent of epidural anesthesia and antacids has greatly reduced the risk of pulmonary complications. Morbidity from pulmonary aspiration is so rare that it is impossible to examine this outcome in a randomized controlled trial; in both the United States and the United Kingdom, maternal death from the aspiration of pulmonary contents has virtually disappeared.<sup>14,15</sup> Pulmonary aspiration can be avoided, even in the presence of oral intake, with properly trained obstetric anesthesia personnel.<sup>16,17</sup> Thus, current evidence suggests that there is no risk in allowing oral intake of clear fluids during labor.

### Limitations

There are some limitations in our work that are worthy of further discussion. Because of lower than projected recruitment in the IV fluid group (37 instead of 40 patients), the study had a 79% (instead of 80%) likelihood of demonstrating a shortening of the total duration of labor by 25%. Also, the sample size may not have been adequate to detect differences in the secondary outcome of oxytocin augmentation rates. The lower rate of augmentation in the usual care group provides reassurance that the overall study findings are valid.

Second, fluid volume measurements were dependent on prospective recording by busy labor and delivery nurses, a situation that could have led to recording errors. Because of the large number of nurses (45) that participated in the study, there is little reason to believe that any systemic errors occurred between the groups.

Third, the average total length duration of labor was higher in our study compared to other trials. The women in the Iranian trial<sup>5</sup> probably had much shorter labors (about 320 minutes) than the other US trial and this study because of the unavailability of epidural anesthesia. Our study's average labor duration (9.4 hours or 560 minutes) was probably higher than that in the other US study<sup>4</sup> (about 500 minutes) due to our women being admitted in an earlier stage of labor, as evidenced by differences in admission cervical exam, ie, lower dilation, higher station, and lower effacement.

Table 2

### Labor Outcomes

Outcome	Usual Care (n=43)	IV Fluid (n=37)	P Value
Mean duration of first stage (hours)*	8.0	7.9	.90
Mean duration of second stage (hours)*	1.4	1.6	.49
Mean total duration of labor (hours)*	9.4	9.5	.92
Labor >12 hours (%)*	23	24	.86
Labor augmentation with oxytocin (%)	44	51	.52
Method of delivery (%)			
Spontaneous	81	68	.30
Vacuum/forceps	12	22	
Cesarean section	7	11	

\* Vaginal deliveries only

Lastly, women were recruited in prenatal settings in which the study rationale was discussed. It is possible that women entered labor believing in the benefits of adequate hydration and drank more than they otherwise would have. The similar volume of oral fluid between groups mitigates the likelihood of this affecting the study outcomes.

### Conclusions

In summary, an increased rate of intravenous hydration showed no benefit in labor progression over usual care when women were allowed to drink freely. Permitting women in labor to consume clear fluids maintains adequate intravascular volume while minimizing the risk of fluid overload and carries an exceedingly low risk of pulmonary aspiration. Future studies may wish to reevaluate the benefit of increased intravenous hydration in labor, as well as the role of supplemental oral hydration.

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