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Maternal Oral Hydration with Hypotonic Solution (Water) Increases Amniotic Fluid Volume in Pregnancy

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Summary

The effect of maternal oral hydration with water on amniotic fluid volume was evaluated in pregnant women with normal amniotic fluid index (AFI 8.0-24.0cm). Fifty women were made to drink 2 litres of water over 1 hour (hydration group) 3 hours before repeat AFI measurement, while 50 women in control group were allowed only 100ml. The pre- and post-treatment AFI and maternal urine specific gravity were compared between the two groups. The data was analysed with paired t-test for statistical significance. The mean AFI in the hydration group increased significantly by 2.01 ± 3.73cm ($P<0.001$), whereas it declined significantly by 0.51 ± 1.12cm ($P<0.001$) in the control group. The maternal urine specific gravity decreased in the hydration group significantly.

In conclusion, maternal hydration status has a role in the regulation of amniotic fluid volume. Oral hydration with hypotonic solution (water increases AFI, probably by causing osmotic change. Whether maternal oral hydration will be of therapeutic value in women with oligohydramnios needs to be studied.

Introduction

Amniotic fluid (AF) is essential for the normal growth and well being of the fetus (Chamberlain et al, 1984; Shymoys et al, 1990). Intrauterine growth restriction and chronic fetal hypoxia, in the absence of fetal malformations (especially renal) are associated with oligohydramnios. Decreased AF may be responsible for fetal and umbilical cord compression, meconium staining, increased perinatal mortality and morbidity, and operative delivery (Hofmeyr, 1999). The clinical need to increase amniotic fluid volume in pregnancies with oligohydramnios has prompted research into its normal regulation. Amniotic fluid volume is the result of a balance between its absorption and production. Various factors have been described to be involved in this dynamic process, the most well known being fetal urination and swallowing (Hashimoto et al 1993, Brace, 1989).

Recently, it has been shown in the literature that amniotic fluid volume is also regulated by maternal hydration status (Scherer et al, 1990; Doi et al, 1998). Maternal osmolality or fluid volume may have a direct impact on amniotic fluid volume. Amnioinfusion (Fisk, 1991), intravenous fluid therapy (Brace, 1989) have been used to favourably improve AFI in pregnant women with oligohydramnios. However, a non-invasive, easy method such as oral water intake, if effective, would be preferred. The objective of this study was to assess the effect of maternal oral hydration on normal amniotic fluid volume.

Material and Methods

The study population consisted of 100 women with normal singleton pregnancies beyond 32 weeks of gestation, attending the antenatal clinic, Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences. Women with diabetes mellitus, renal disease, ruptured membranes or with fetal malformations on ultrasound were excluded from the study.

Only women with normal AFI (8.0-24.0cm) were included in the study, and randomly divided into (1)

hydration and (2) control groups, of 50 cases each. The Amniotic Fluid Index (AFI) was calculated by the four quadrant technique described by Phelan (1987). The maternal urine specific gravity was measured by urinometer or urine test-strips.

The AFI and urine specific gravity of each case were measured, after which women in the hydration group were instructed to drink 2 litres of water over a period of one hour, and the control group to drink only 100 ml of water during one hour. Women who could not drink 2 litres of water in one hour or who vomited were excluded from the study. The women were then made to rest in bed in a comfortable environment. Repeat AFI by the same observer and the maternal urine specific gravity were measured 3 hours after the women had finished drinking the water.

The difference between the post- and pre-treatment AFI and urine specific gravity were calculated and referred to as "delta AFI" and "delta urine specific gravity", respectively. The data was analysed with paired student t-test for statistical significance.

Results

Maternal oral hydration was associated with a significant increase in AFI. The AFI increased by a mean of 2.01 ± 3.73cm (Range: 2.0 to + 7.0 cm) after hydration ($P<0.001$). This represents a mean percent increase of 15.97% in AFI. Conversely, the AFI declined significantly in the control group by a mean of 0.51 ± 1.12 cm (Range -2.0 to 1.3cm) ($P<0.001$), the mean percent decrease being 4.12%. (Table I)

The maternal urine specific gravity decreased by a mean of 8.12 ± 8.40 ($P<0.0001$) with hydration and increased by 2.68 ± 6.46 in control group ($P<0.001$). The delta urine specific gravity had a significant negative correlation with the delta AFI. The regression coefficient between the change in urine specific gravity and the change in AFI was found to be R=-035($P<0.05$) in the hydration group and R=-0.42 ($P<0.05$) in the control group.

The pregnant women in the hydration and control groups were matched for age, parity, and period of gestation. No complications due to acute water intake occurred in any of the patients.

Discussion

Maternal oral hydration with 2 litres of water (Hypotonic solution) in women with normal amniotic fluid was associated with significant 15.97% increase in AFI. This finding suggests that maternal hydration status has an important role to play in the normal regulation of amniotic fluid volume, besides other factors such as fetal urination and fetal swallowing. Amniotic fluid volume regulation and response to fluid infusion or withdrawal has been studied in animal experiments, but very few studies have been carried out in humans.

Oral water loading and arginine-vasopressin induced decreased maternal plasma osmolality decreases ovine fetal osmolality, with subsequent increase in fetal urine flow rate and increase in amniotic fluid volume (Ross et al, 1996). Maternal hydration and the reset (lower) maternal and fetal plasma hypotonicity results in suppression of spontaneous fetal swallowing activity in ewes, probably from tonic dipsogenic stimulation (Nijland et al, 1998). Fetal swallowing being a major route of amniotic fluid resorption, suppressed swallowing activity increases amniotic fluid volume.

The results obtained in our study were found to

Table I: The effect of maternal hydration in women with normal AFI

	Hydration group (N=50)	Control group (N=50)
Pre-treatment AFI (in cm)	13.01 ± 3.76 (Range = 10.1 to 16.9 cm)	12.32 ± 2.89 (Range = 8.8 to 16.6 cm)
Urine Sp. gravity	1020.64 ±12.04 (Range=1010 to 1030)	1016.88 ± 7.35 (Range=1010 to 1025)
Post-treatment AFI (in cm)	15.02 ± 5.05 (Range=10.1 to 20.4cm)	11.81 ± 3.03 (Range=7.6 to 15.7)
Urine Sp. gravity	1012.52 ± 1086 (Range=1005 to 1025)	1019.56 ± 6.52 (Range=1010 to 1025)
Delta AFI (in cm)	2.01 ± 3.73	- 0.51 ± 1.12
% change in AFI	15.97 ± 0.3%	- 4.12 ± 0.09%
Delta Urine Sp. gravity	- 8.12 ± 8.40	2.68 ± 6.46
% change in Sp. gravity	- 0.79 ± .008%	0.26 ± .006%

be comparable to those reported by Kilpatrick and safford (1993) who demonstrated a 16% increase in AFI with maternal hydration in women with normal amniotic fluid volume. The Cochrane Library (Oxford) search of the Cochrane Pregnancy and Childbirth Group Trials register and the Cochrane Controlled Trials Register showed only two studies of 77 women, with and without oligohydramnios (Hofmeyr, 1999). The women were asked to drink two litres of water before having an ultrasound. Acute maternal hydration was associated with increase in amniotic fluid volume (weighted mean difference for women with normal amniotic fluid volume 4.5, 95% confidence interval 2.92 to 6.08). No clinically important outcomes were assessed. The reviewers conclusion was that simple maternal hydration appears to increase amniotic fluid in women with normal AFV. It may be beneficial in the management of oligohydramnios in pregnancy and labour.

Comparison of the effect of three methods of maternal hydration on the AFI in oligohydramnios: IV isotonic fluid (2 litres/2 hours), IV hypotonic fluid (2 litres/2 hours) and oral water intake (2 litres/2 hours) demonstrated significant increase in amniotic fluid volume with IV hypotonic fluid infusion and oral water intake only (2.8 ± 1.9, P<0.001; 3.8 ±1.9, p<0.001 respectively) (Doi et al, 1998). Significant decreases in maternal hematocrit and hemoglobin concentration were found only after IV isotonic maternal hydration (32.0 ± 2.9 to 29.5 ± 2.3, p<0.001; 11.0 ± 1.6 to 10.1 ± 1.4, p<.001) compared to IV hypotonic fluid or oral water hydration. Thus, fall in maternal osmolality and not volume expansion correlated with increase in AFI. Oral hydration is a more cost effective and simpler method than IV hydration which may require hospitalization. Hypotonic expansion of the maternal extracellular fluid compartment with administration of a solution (5% glucose), but not hypertonic expansion (mannitol) causes hypotonicity in the fetus by the mechanism of osmotic gradient across the placenta (Battaglia et al, 1960). Increase in uterine artery mean flow velocity has been observed indicating improved uteroplacental perfusion (Flack et al, 1995).

Urine specific gravity is an estimate of the hydration state, which falls with hydration and increases with dehydration. Urine specific gravity correlates with urine osmolality which in turn reflects plasma osmolality. Significant reduction in maternal plasma and urine osmolality occurs after acute oral hydration (Lumbers & Stevens, 1983; Stevens & Lumbers, 1985; Brace & Moore, 1991). It is apparent in our study, that oral hydration decreases maternal osmolality, as supported by parallel fall in urine specific gravity. Women with diabetes and renal disease were excluded from our study as these conditions could affect the maternal and hence fetal plasma and urine osmolality. Fetal congenital anomalies were also excluded as they may affect the formation of amniotic fluid.

Brace & Moore (1991) demonstrated that two hours were necessary before direct fetal volume infusion in sheep was associated with a significant increase in AFV. In humans, it has been shown that water in the amniotic fluid is replaced every 3 hours (Goodlin, 1983), hence 3 hours was the time used in our study to measure the effect of hydration on amniotic fluid volume.

In conclusion, our study strongly suggests that maternal hydration status has a definite role in amniotic fluid regulation and oral hydration increases amniotic fluid volume in normal pregnancy. Maternal hydration with hypotonic solution (water) causes osmotic change, which relates to parallel decrease in fetal osmolality, increased fetal urine flow and formation of amniotic fluid. Whether maternal oral hydration will be of therapeutic value in women with oligohydramnios needs to be studied.

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