

The Effects of Intravenous Hydration on Amniotic Fluid Volume and Pregnancy Outcomes in Women with Term Pregnancy and Oligohydramnios: A Randomized Clinical Trial

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ARTICLE INFO

Article type:
Original Article

Article History:
Received: 15 Jan. 2012
Accepted: 28 Feb. 2012
ePublished: 25 Aug. 2012

Keywords:
Hydration of mothers
Oligohydramnios
Amniotic fluid index
Clinical trial

ABSTRACT

Introduction: Amniotic fluid is an important factor in the prediction of fetal survival. The aim of this research was to evaluate the effects of intravenous hydration of mothers on amniotic fluid volume and in turn on pregnancy outcomes. **Methods:** The current single blind controlled clinical trial was conducted on 20 pregnant mothers with amniotic fluid index of lower or equal to 5 cm and gestational age of 37-41 weeks. The subjects were divided into two groups of case and control through simple random sampling. Amniotic fluid index was measured in all participants. The case group received one liter of isotonic saline during 30 minutes by the bolus method. Reevaluations of amniotic fluid index in both groups were made 90 minutes after baseline measurement. Independent t-test and paired t-test were used to compare the two groups and mean amniotic fluid index before and after treatment, respectively. **Results:** Hydration of mothers significantly increased the amniotic fluid index in the case group (mean change: 1.5 cm; 95%CI: 0.46 - 2.64; P = 0.01). The mean change of amniotic fluid index in the control group did not significantly increase (P = 0.06). The elevation of amniotic fluid index in the hydration group (32%) was significantly higher than the control group (1%) (P = 0.03). **Conclusion:** In this study intravenous hydration increased amniotic fluid index of mothers with term pregnancy and oligohydramnios. Since it caused no complications for the mother and the fetus, it can be used as an effective method in management of oligohydramnios.

Introduction

Amniotic fluid acts as a protective cushion for the fetus against the pressures placed on the abdomen, keeps the temperature of the fetus stable, and prevents attachment to the fetal membranes. In addition, the floating characteristics of amniotic fluid facilitate the movement and symmetrical growth of the fetus.¹

Reduction in the amniotic fluid (oligohydramnios) affects 1-5% of term pregnancies.² Some cases of amniotic fluid reduction are accompanied by fetus growth disorders, urinary tract obstruction or renal agenesis, chronic leaks from gaps in the fetal membranes, and in 15-25% of cases fetal abnormalities.²

Oligohydramnios, in the absence of premature rupture of membranes and fetal anomalies, is considered as a symptom of

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This study was approved by the ethics committee of Tabriz University of Medical Sciences, Tabriz, Iran (ethical code: 8661; project number: 5/4/8283; IRCT number: 201112146709N7).

chronic reduction in placental function, which results in reduction of fetal urinary output.³ Oligohydramnios affects the pregnancy result and the health of the fetus. In rare cases, the amniotic fluid volume may become less than its normal amount. In some cases, it may even be reduced to a few milliliters of viscous fluid which results in an increase in fetal death to 40-50 times of the rates among normal pregnancies.^{2,4}

Previous research has reported the consequences of decreased fluid index to include increased danger of cesarean because of fetal distress, decreased Apgar score to lower than 7 in the fifth minute,^{5,6,7} danger of preterm labor, stillbirth and non-reassuring heart rate, admittance to the neonatal intensive care unit, and meconium aspiration syndrome.⁸ Fetal hypoxia may also occur as a consequence of umbilical cord prolapse caused by rupture of the water sac, or because of cord compression caused by reduction of fluid resulting in dropped fetal heart rate.^{9,10}

Many factors may affect the amniotic fluid index. The mothers' blood volume plays an important role in maintaining the amniotic fluid volume.¹¹ Hydration status and maternal plasma osmolality can also alter amniotic fluid volume.^{2,12,13}

Kilpatrick and Safford found that fluid limitation reduced amniotic fluid volume up to 8%. They also showed that oral hydration with 2 liters of liquid after 2 hours, increased amniotic fluid volume up to 16% in pregnancies with normal amniotic fluid, and up to 31% in women with reduced fluid.¹⁴ Some studies have suggested that although oral hydration increases the amount of amniotic fluid in women with oligohydramnios, no significant increase would be observed in women with normal amniotic fluid volume.^{11,15}

Doi *et al.* showed a significant increase in the amniotic fluid index of oligohydramnios in women above 35 weeks of gestation using oral hydration as well as intravenous (IV) injection of hypotonic solutions. However, no increase in amniotic fluid index was observed

with injection of isotonic solutions.¹³ On the other hand, Megann *et al.* reported elevated levels of amniotic fluid index after IV hydration using isotonic solution.¹²

Previous studies on the effects of hydration on amniotic fluid index have had different results. Moreover, no research has been conducted on the effects of hydration of the mother on clinical results such as reduction of fetal heart rate during labor, neonatal results, and fetal Apgar score.¹⁶ Therefore, the current study was performed to determine the effects of IV hydration with isotonic saline on amniotic fluid index and pregnancy outcomes (fetal distress, Apgar score, meconium staining, and cesarean section because of fetal distress).

Materials and methods

This single blind clinical trial aimed to determine the effects of IV hydration of mothers on amniotic fluid volume and pregnancy outcome in Alzahra Hospital, affiliated to Tabriz University of Medical Sciences (Tabriz, Iran). Women who referred to the maternity ward of the hospital for a checkup and had the inclusion criteria were randomly allocated into the case and control groups. Pregnant women were included if they had an amniotic fluid index ≤ 5 , a gestational age of 37-41 weeks (based on the last menstrual period and confirmed by the results of ultrasound or determined through early pregnancy sonography), cephalic presentation, no prior history of cesarean section, no pregnancy complications such as gestational hypertension, bleeding, no known systemic disease before and during pregnancy (systemic disease), and intact fetal membranes. Mothers whose contractions had begun were not included. Moreover, the participants had no prior history of kidney, lung, and heart disease since the use of bolus-fluid therapy is contraindicated in these patients. The biophysical profile score of the study subjects was 8 and they had no fetal complications (intrauterine growth retardation or obvious fetal anomalies). The exclusion criteria of the study were spontaneous onset of labor

contractions and reduction of fetal heart rate during hydration.

Using the formula for comparison of means between two groups and based the existing data of this study,¹⁷ number of subjects was calculated to be 10 people per group. After receiving informed written consents from the term pregnant women with the fluid index of equal or less than 5 who had the inclusion criteria of this study, they were randomly assigned to one of the intervention (A) and control (B) groups by a computerized table of random numbers. Data was collected by an observation sheet that was prepared by the researcher based on information from books and articles. The validity of the sheet was determined by the content validity method.

We assessed amniotic fluid volume through calculating amniotic fluid index, i.e. by summing the vertical depth of the greatest cavity in each equal quadrant of the uterus.² Amniotic fluid index was measured in every participant by a radiologist while heparin lock was used. Portable sonography was performed by a SonoSite machine (SonoSite Inc., USA). Since the blinding of mothers was not possible, only the sonographer was blinded. The sonographer was thus not informed about the groupings. To avoid bias, the ultrasound of each mother before and after the study was performed by the same sono-

grapher. All mothers were at rest and allowed to use the restroom. Since resting increases the placental blood circulation of the uterus, which is considered to be a confounding factor in this study, it was applied to both case and control groups.

The case group received one liter of isotonic saline by the bolus method during 30 minutes through IV infusion. Amniotic fluid index was reevaluated 90 minutes after baseline, i.e. one hour after the completion of fluid therapy, in both case and control groups. The patients had empty bladders at the time of remeasurement of amniotic fluid index. Labor was then induced in both groups. During labor, fetal heart rate was continuously controlled through external monitoring. The average values of baseline amniotic fluid index and the remeasured index (after 90 minutes) in the two groups were compared using paired t-test. In addition, the mean difference of amniotic fluid index of the two groups was compared by an independent t-test. All data analyses were performed in SPSS¹³ (SPSS Inc., Chicago, IL, USA).

Results

Demographic information and hydration results of the study population are summarized in Tables 1 and 2, respectively.

Table 1. Frequency distribution of demographic information

Variables	Control group (n = 10)	Hydrated group (n = 10)	P
Age (years)	23.81 (4.49)	29.1 (7.35)	0.05
Gestational age (weeks)	39.37 (0.78)	38.6 (1.28)	0.42
Amniotic fluid index	4.18 (1.25)	4.7 (0.67)	0.25

Values are expressed as mean (SD).

Table 2. Amniotic fluid index (AFI) before and after treatment in the case and control groups

	Control group (n = 10)	Hydrated group (n = 10)
AFI before treatment	4.18 (1.25)	4.70 (0.67)
AFI after treatment	4.59 (1.41)	6.25 (1.85)
Difference of AFI after and before treatment	0.41 (0.62)	1.55 (1.51)
P	0.06	0.01

Values are expressed as mean (SD).

In the hydrated group, mean amniotic fluid index significantly increased from 4.70 to 6.25 cm (mean difference: 1.5 cm; 95% CI: 0.46-2.64; P = 0.01). While amniotic fluid index increased from 4.18 to 4.59 cm (mean

difference: 0.41; 95% CI: -0.01- 0.83; P=0.06) in the control group, the difference was not significant. There was a 32% increase in amniotic fluid index in the hydration group which was significantly higher than the 0.1%

increase of the control group ($t = 2.29$; $P = 0.03$).

In addition, evaluating fetal heart rate revealed bradycardia in 10% of the hydration group and 27.3% of the control group. However, Fisher's exact test showed no significant statistical difference between the two groups ($P = 0.58$).

Meconium staining of the amniotic fluid was observed in 20% of the cases and 36.4% of the controls. The Fisher statistical test results showed no significant statistical difference between the two groups. ($P = 0.63$)

Cesarean section was performed in 30% of the hydration group and 45.5% of the control group. However, based on Fisher's exact test, the difference between the two groups was not statistically significant ($P = 0.65$).

Discussion

The results of the current study showed that IV hydration caused a significant increase in the amniotic fluid index in the hydration group. This increase might have been due to acute changes in amniotic volume or the maternal plasma osmolality.

Similarly, Umber and Chohan suggested that hydration of mothers with term pregnancy and oligohydramnios caused the amniotic fluid volume to increase (mean change of amniotic fluid index: 4.5 cm; 95% CI: 4.02-5.06; $P < 0.1$).¹⁷

Previous studies have indicated that improvements of uterine placental perfusion, as a result of increased plasma volume in mothers, would increase renal blood flow and improve fetal oxygenation. Decreased vasopressin and increased urinary output would thus be observed.¹⁸ On the other hand, the fetus will compensate for the acute changes in maternal plasma osmolality by the reduction of plasma osmolality and increasing urinary output which in turn increases the amniotic fluid volume.¹⁹ In accordance with our study, Magann *et al.* showed that amniotic fluid volume and amniotic fluid index increased significantly after hydration of mothers with

natural pregnancies. They reported the mean amniotic fluid index as 8.6 cm before hydration and the mean change as 1.7 cm.¹² Although hydration of mothers increases amniotic fluid index, the mechanism of these changes is not clear. This study was not designed to answer this question.

Doi *et al.* showed that hydration of mothers modified their osmolality and thus increased amniotic fluid volume more than blood volume.¹³ On the other hand, Flack *et al.* revealed that hydration of mothers decreased plasma osmolality and urine. Moreover, amniotic fluid index increased in the oligohydramnios group. The mean change of amniotic fluid index was 3.2 cm, and the uterine artery blood flow velocity significantly increased. The researchers stated that this increase could have been due to increased uterine placental perfusion.¹⁵ Kilpatrick and Safford showed a significant increase in the mean arterial flow velocity after hydration of mothers. They proposed that hydration may increase amniotic fluid index by improving placental blood flow.¹⁴

Decreasing of amniotic fluid decreases fetal movement freedom and increases the risk of increased umbilical cord pressure which is followed by the risk of hypoxia and fetal death.¹ The findings of the current study showed fetal bradycardia to be 27.3% and meconium staining of the amniotic fluid to be 36.4% in the control group. The corresponding values in the hydration group were 10% and 20%, respectively.

Oligohydramnios is one of the main factors in the prediction of caesarean section.²⁰ In the current study, cesarean section was performed in 30% of the cases and in 45.5% of the controls.

This study did not evaluate the long-term effects of hydration. However, Malhotra and Deka assessed amniotic fluid index of 25 pregnant women 3, 24, and 48 hours after hydration of the mother with 2 liters of saline during one hour. They found that hydration of the mother increased amniotic fluid index

in women with normal amniotic fluid index and oligohydramnios. However, this effect lasted less than 24 hours.²¹ More research is necessary on this topic.

Conclusion

The complications of oligohydramnios cause the mother and the fetus to suffer from many problems. Therefore, hydration of the mother is recommended as a low-cost method with no complications for the fetus and the mother.

Most of the previous research on this topic has been conducted on a limited number of participants and the mothers were with a gestational age of higher than 37 weeks and close to term. More research with higher number of subjects and in different gestational ages is necessary. If confirmed, applying this method in mothers with oligohydramnios and gestational age of lower than 35 weeks can eliminate the need to terminate the pregnancy before term which has terrible consequences on the mother and the fetus.

Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

Acknowledgments

We would like to thank the deputy of research at Tabriz University of Medical Sciences for their financial support. We also appreciate all pregnant mothers participating in this research.

References

1. Mckinne ES, James SR, Murray SH, Ashwil J. *Maternal-Child Nursing*. 3rd ed. Philadelphia: Elsevier Health Sciences; 2008. 245-322 p.
2. Cunningham FG, Williams JW, Leveno KJ, Bloom S, Hauth JC. *Williams Obstetrics*. 23rd ed. New York: McGraw-Hill Medical; 2009.495p.
3. Yang LC, Taylor DR, Kaufman HH, Hume R, Calhoun B. Maternal and fetal outcomes of spontaneous preterm premature rupture of membranes. *J Am Osteopath Assoc* 2004; 104(12): 537-42.
4. Gibbs RS, Danforth DN, Karlan BY, Haney AF. *Danforth's Obstetrics and Gynecology*. 10th ed. New York: Lippincott Williams & Wilkins; 2008. 142 p.
5. Chauhan SP, Sanderson M, Hendrix NW, Magann EF, Devoe LD. Perinatal outcome and amniotic fluid index in the antepartum and intrapartum periods: A meta-analysis. *Am J Obstet Gynecol* 1999 Dec; 181(6): 1473-8.
6. Baron C, Morgan MA, Garite TJ. The impact of amniotic fluid volume assessed intrapartum on perinatal outcome. *Am J Obstet Gynecol* 1995 Jul; 173(1): 167-74.
7. Shipp TD, Bromley B, Pauker S, Frigoletto FD, Benacerraf BR. Outcome of singleton pregnancies with severe oligohydramnios in the second and third trimesters. *Ultrasound Obstet Gynecol* 1996 Feb; 7(2): 108-13.
8. Casey BM, McIntire DD, Bloom SL, Lucas MJ, Santos R, Twickler DM, et al. Pregnancy outcomes after antepartum diagnosis of oligohydramnios at or beyond 34 weeks' gestation. *Am J Obstet Gynecol* 2000; 182(4): 909-12.
9. Ott WJ. Reevaluation of the relationship between amniotic fluid volume and perinatal outcome. *Am J Obstet Gynecol* 2005; 192(6): 1803-9.
10. James DK, Steer PJ, Weiner CP, Gonik B. *High Risk Pregnancy: Management Options*. 4th ed. Philadelphia: Elsevier Health Sciences; 2010.1321-28 p.
11. Calhoun S. Focus on fluids. Examining maternal hydration and amniotic fluid volume. *AWHONN Lifelines* 1999 Dec-2000 Jan; 3(6): 20-4.
12. Magann EF, Doherty DA, Chauhan SP, Barrilleaux SP, Verity LA, Martin JN, Jr. Effect of maternal hydration on amniotic fluid volume. *Obstet Gynecol* 2003; 101(6): 1261-5.
13. Doi S, Osada H, Seki K, Sekiya S. Effect of maternal hydration on oligohydramnios: a comparison of three volume expansion methods. *Obstet Gynecol* 1998 Oct; 92(4 Pt 1): 525-9.
14. Kilpatrick SJ, Safford KL. Maternal hydration increases amniotic fluid index in women with normal amniotic fluid. *Obstet Gynecol* 1993 Jan; 81(1): 49-52.
15. Flack NJ, Sepulveda W, Bower S, Fisk NM. Acute maternal hydration in third-trimester oligohydramnios: effects on amniotic fluid volume, uteroplacental perfusion, and fetal blood flow and urine output. *Am J Obstet Gynecol* 1995 Oct; 173(4): 1186-91.
16. Leeman L, Almond D. Isolated oligohydramnios at term: is induction indicated? *J Fam Pract* 2005; 54(1): 25-32.
17. Umber A, Chohan MA. Intravenous maternal hydration in third trimester oligohydramnios: effect

- on amniotic fluid volume. *J Coll Physicians Surg Pak* 2007; 17(6): 336-9.
- 18.** Robillard JE, Weitzman RE, Burmeister L, Smith FG, Jr. Developmental aspects of the renal response to hypoxemia in the lamb fetus. *Circ Res* 1981 Jan; 48(1): 128-38.
- 19.** Oosterhof H, Haak MC, Aarnoudse JG. Acute maternal rehydration increases the urine production rate in the near-term human fetus. *Am J Obstet Gynecol* 2000; 183(1): 226-9.
- 20.** Muris C, Girard B, Creveuil C, Durin L, Herlicoviez M, Dreyfus M. Management of premature rupture of membranes before 25 weeks. *Eur J Obstet Gynecol Reprod Biol* 2007; 131(2): 163-8.
- 21.** Malhotra B, Dekka D. Duration of the increase in amniotic fluid index (AFI) after acute maternal hydration. *Arch Gynecol Obstet* 2004; 269(3): 173-5.