

# Oligohydramnios and Polyhydramnios: Mechanisms and Therapy

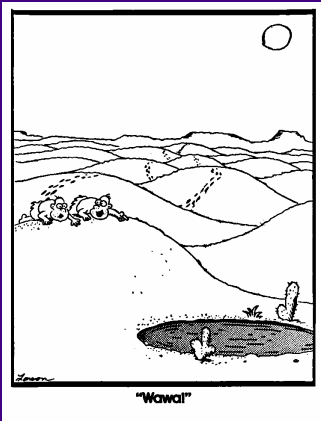
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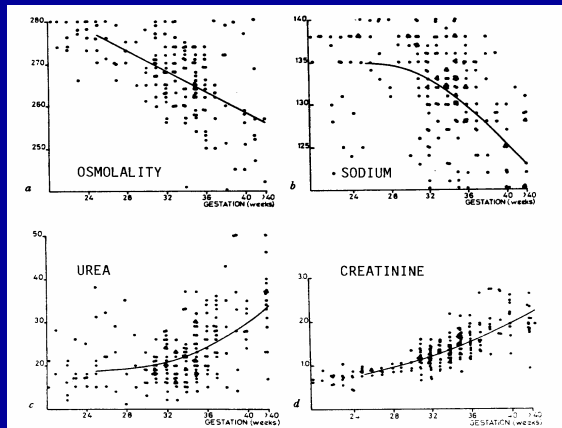
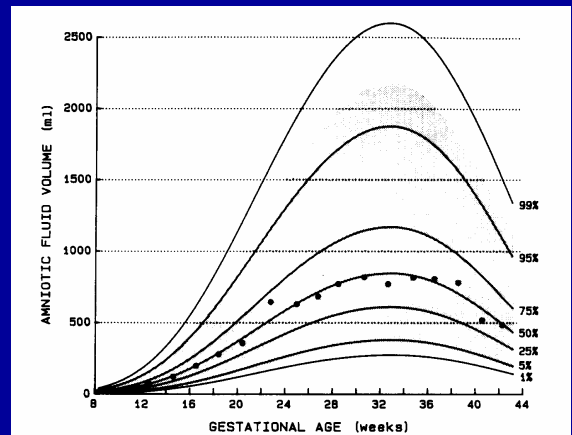
## Amniotic Fluid Functions

- Prevents compression
  - Anatomical development
  - Pulmonary maturation
  - Umbilical cord
- Fetal Protection
  - Trauma
  - Infection
- Nutrition, water and electrolytes

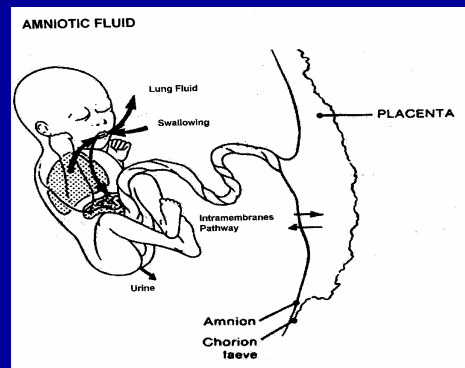
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## Amniotic Fluid Circulation

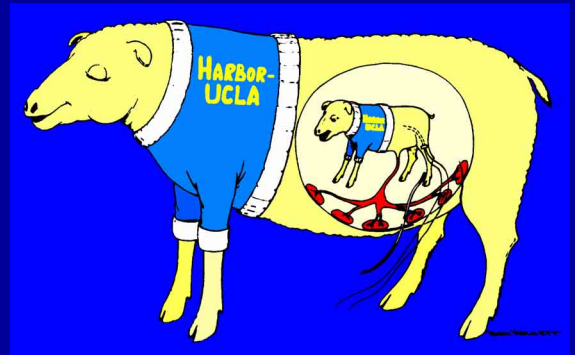


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## Main Concepts

- Amniotic fluid is a fetal water compartment
- Amniotic fluid is maintained by a balance of fluid secretion and resorption
- Fetal endocrine factors and body fluid responses regulate fluid secretion and resorption
- Maternal alterations influence fetal fluid and endocrine responses and thus amniotic fluid

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## Fetal Urine Production

- Renal blood flow: 2-4% cardiac output
- GFR: 1 ml/kg/min
- Osmolality: <180 mOsm/kg
- Volume: 500-1000 ml/day near term

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## Regulation of Urine Production

- Renal blood flow
  - Renin-angiotensin: vasoconstriction
  - Beta-2 sympathetics: vasodilation
  - PGE<sub>2</sub>: vasodilation
- Tubular action
  - Arginine vasopressin: antidiuresis
  - Aldosterone: antinatriuretic
  - Atrial natriuretic factor: natriuresis and diuresis

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## Fetal lung fluid production

- Active chloride secretion
- Isotonic with fetal plasma: 290-300 mOsm/kg
- Protein free
- Volume: 250-350 ml/day near term
  - 50% swallowed

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## Regulation of fluid production

- Decreased fluid
  - Arginine vasopressin
  - Epinephrine
  - Cortisol
  - Atrial natriuretic factor
- Increased fluid?
- Lung fluid promotes lung development

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## Fetal Swallowing

- Bouts of activity during "active" sleep
- Volume: 500-1000 ml/day of amniotic fluid near term
  - Second trimester: 4% of AF per day
  - Third trimester: 50-100% of AF per day

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## Regulation of Fetal Swallowing

- Fetal behavioral state: hypoxia
- Thirst: maternal dehydration
- Availability of fluid
- Taste, hunger, sodium appetite?

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## Intramembranous flow

- Flow across amnion and chorion to fetal vasculature
- 200 ml/day (estimated)
- Balances production and resorption
- Increases with absent swallowing
- Amniotic fluid recirculation

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## Additional Sites of Amniotic Fluid Exchange

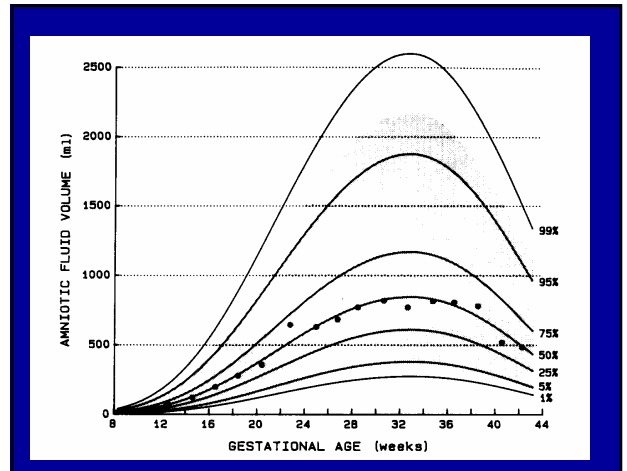
- Fetal skin
- Fetal-placental surface
- Umbilical cord
- Transmembrane flow to mother
- Salivary glands
- Abdominal or CNS defects

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## Amniotic Fluid Volume

- 8 weeks: 15 ml, volume increases 10 ml/week
- 17 weeks: 250 ml, increases at 50 ml/week
- 28-38 weeks: ~750 ml
  - decreases beginning at 34 weeks
- 42 weeks: <500ml

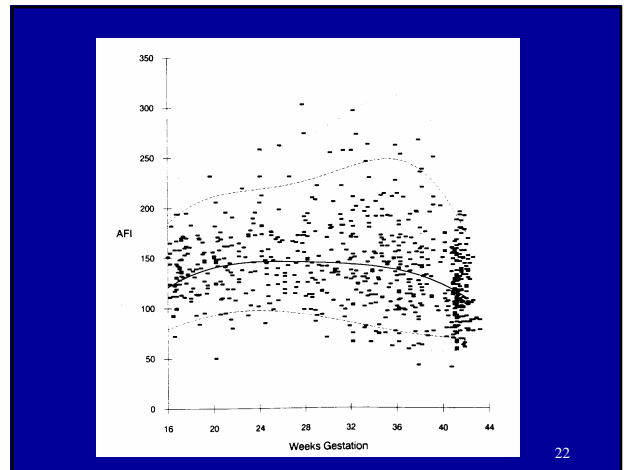
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## Amniotic Fluid Index

- Uterus divided into 4 quadrants
- Transducer in vertical plane
- Sum of 4 quadrants maximal pocket depth
- Variations?
  - transducer in sagittal alignment
  - Cord and limbs
  - Prior to 20 wks: 2 halves
  - Twins: composite AFI or individual vertical pockets

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## Polyhydramnios

- Incidence: 0.4 - 1.5%
- Diagnosis:
  - Clinical: Size > Dates
  - Ultrasound: 10 cm pocket; AFI > 25
  - Delivery: > 2000 ml fluid

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	SEVERITY OF POLYHYDRAMNIOS AND ASSOCIATED MATERNAL/FETAL CONDITIONS				
	No.	(%)	Polyhydramnios		
Mild			Moderate	Severe	
	102	(100)	79	19	4
Idiopathic	68	(66.7)	66	2	
Anomalies	13	(12.7)	2	9	2
Insulin-dependent diabetes	8	(7.8)	3	5	
Gestational diabetes	7	(6.9)	7		
Twins	5	(4.9)	1	2	2
Other maternal/Fetal diseases	1	(1.0)		1	

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## Polyhydramnios: Complications and conditions

- Uterine overdistention
  - Maternal respiratory compromise
  - Premature labor
  - Premature rupture of membranes
    - Abruption
    - Cord prolapse
  - Fetal malpresentation
  - Postpartum hemorrhage
- Fetal congenital malformations
- Fetal macrosomia

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## Mechanisms of polyhydramnios

- Increased urine production
- Increased lung fluid production
- Decreased swallowing
- Altered intramembranous flow

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## Polyhydramnios: Etiologies

- Increased urine flow
  - Maternal: diabetes
  - Fetal: anemia, cardiac disease, ADH insufficiency, partial renal obstruction, twin transfusion
- Increased lung fluid
  - Fetal cystic adenomatoid malformation
- Reduced swallowing
  - Fetal anencephaly, GI obstruction, myotonia dystrophica

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## Polyhydramnios: Etiologies

- Placenta: Chorioangioma, circumvallate
- Fetal
  - Skeletal malformations: osteo. imperfecta
  - Fetal tumors: teratomas
  - Genetic disorders (trisomy, multiple congenital malformations)
  - Intrauterine infections: rubella, toxo, syphilis
  - Nonimmune hydrops

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## Polyhydramnios: Evaluation

- Maternal blood: antibody and diabetes screen, Hb electrophoresis, AFP, TORCH
- Ultrasound:
  - Twins, congenital anomalies, hydrops
  - Fetal urine production
- Amniotic fluid: AFP, chromosomes, lung maturity
- Placental biopsy, PUBS

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## Polyhydramnios: Therapy

- Treatment of etiology
- Bed rest
- Amniocentesis
- Antepartum monitoring
- Tocolytics, glucocorticoids
- Indomethacin
- ? Diuretics, low sodium diet

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## Polyhydramnios: Indomethacin

- **Ultrasound:** Anomalies, fetal urine flow, ductal flow
- **Amniocentesis:** 1 - 1.5 liters
- **Indomethacin:** 25-50 mg q 6 hours
- **Ultrasound at 24 hours and weekly**
  - Monitor AFI, urine flow, and ductal flow
- **Risks:** oligohydramnios, neonatal oliguria, patent ductus, ileal perforation

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## Oligohydramnios

- **Incidence:** 8.2 to 37.8 % pregnancies
  - 8.2 % of antenatal patients (50% postterm)
  - 37.8 of laboring patients (50% ROM)
- **Diagnosis**
  - Clinical: Size < dates
  - Ultrasound: AFI < 5
  - Delivery: Scant fluid, meconium

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## Oligohydramnios: Etiologies

- Rupture of membranes
- Utero-placental insufficiency
  - IUGR, hypoxia
- Congenital anomalies
  - Renal aplasia, obstruction
  - Chromosomal anomalies
- Post-term pregnancy

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## Oligohydramnios: Complications

- IUGR
- Fetal distress
- Operative delivery
- Congenital anomalies
- Meconium aspiration

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## AFI and Outcome

AFI  $\leq$  5 cm

Sarno et al, AJOG 1989

Increased perinatal morbidity, heart rate decelerations

Chauhan et al, J Repro Med 1992

2x increase in neonatal acidosis (<7.2)

Myles et al, Ob &Gyn 1992

Increased mec, low apgar, C/S, acidosis

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## Oligohydramnios: Evaluation

- Maternal medical illness, hypertension, medications
- Ultrasound: Congenital anomalies, IUGR
  - ? Doppler studies
  - ? Amniocentesis

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## Oligohydramnios: Therapy

- Second trimester
  - Transabdominal amnioinfusion: 200 ml
    - Injection of indigo carmine
    - Amniocentesis for chromosomes
    - Diagnostic ultrasound

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## Oligohydramnios: Therapy

- Third trimester
  - Moderate: Bed rest, hydration, ? O2
    - Antenatal monitoring
    - ? PUBS
  - Severe: Delivery
    - Fetal monitoring
    - Amnioinfusion

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## Amnioinfusion Classification

### Therapeutic Amnioinfusion

- Variable decelerations with oligohydramnios
- Variable decelerations with normal AF volume
- Chorioamnionitis

### Prophylactic Amnioinfusion

- Term oligohydramnios
- Preterm premature rupture of membranes
- Meconium

### Prelabor Transabdominal

- Severe oligohydramnios
- Failed version

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## Amnioinfusion: Techniques

Ultrasound assessment: optional

Insert double lumen catheter

Protocol #1:

10 ml/min x 60 min, then 3 ml/min

Monitor intrauterine pressure

Drain fluid if increased tone and fetal distress

Protocol #2:

250 ml at 10-20 ml/min, until AFI > 8 cm

Repeat as necessary

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## Therapeutic Amnioinfusion: Variable Decelerations with Oligohydramnios

- Miyazaki & Taylor, AJOG 1983
  - Preliminary Report 42 patients
- Miyazaki & Nevarez, AJOG 1985
  - Relief of variables: 51 vs 4%
- Owen et al, AJOG 1990
  - Prospective Randomized
  - Reduced C/S for fetal distress (5 vs 16%)

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## Therapeutic Amnioinfusion: Variable Decelerations with Normal AF Volume

Spong, McKindsey, and Ross; AJOG 1996

68 intrapartum patients with variable decels

AFI prior to and following AI bolus (600ml)

Success: >50% decrease in #var decels or >50%

decrease in atypical or severe var decels

AFI increases with amnioinfusion

6.2±3.3 to 10.2±4.0 cm

Probability of success increases with lower AFI

81% if AFI 0-4 cm

33% if AFI > 12 cm

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## **Therapeutic Amnioinfusion: Chorioamnionitis**

Monahan et al, J Repro Med 1995  
ROM > 6 h  
AI decreased chorioamnionitis (25 vs 50%)  
Moen et al, J Repro Med 1995  
C/S following labor  
AI decreased chorioamnionitis (13 vs 38%)  
Ogundipe et al, Ob & Gyn 1994  
Usta et al, Ob & Gyn 1995  
AI increased infection

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## **Prophylactic Amnioinfusion: Term Oligohydramnios**

Reduced C/S, improved cord pH  
Strong et al, AJOG 1990  
Schrimmer et al, AJOG 1991  
MacGregor et al, J Repro Med 1991  
No benefit  
Nageotte et al, Ob & Gyn 1991  
Chauhan et al, J Repro Med, 1992  
ALL COMPARED TO NO-AMNIOINFUSION

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## **Prophylactic Amnioinfusion: Term Oligohydramnios**

Ogundipe, Spong & Ross, Ob & Gyn 1994  
Randomized, controlled study  
116 patients with oligo (AFI < 5cm)  
Prophylactic AI vs Standard Care (therapeutic  
AI for variable decels)  
No difference in C/S, umbilical pH  
22% of standard care received AI

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## **Prophylactic Amnioinfusion: Preterm PROM**

Nageotte et al, AJOG 1985  
61 patients randomized to AI vs no-AI  
Fewer variable decels, improved umbilical  
pH,  
No study comparing prophylactic vs  
therapeutic AI in preterm patients

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## **Prophylactic Amnioinfusion: Meconium**

Less fetal distress, Ces Section,  
meconium below cords, MAS  
Sadovsky et al, AJOG 1989  
Wenstrom & Parsons, Ob & Gyn 1989  
Macri et al, AJOG 1992  
Cialone et al, AJOG 1994  
Eriksen et al, AJOG 1994  
ALL COMPARED TO NO-AMNIOINFUSION

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## **Prophylactic Amnioinfusion: Meconium**

Spong, Ogundipe & Ross, AJOG 1994  
Randomized, controlled study  
93 patients with mod to heavy mec  
Prophylactic AI vs Standard Care (therapeutic  
AI for variable decels)  
No difference in C/S, umbilical pH, Apgar, mec  
below cords  
MAS: 3 in AI group, 1 in standard care  
Increased amnionitis/endometritis with AI

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## Transabdominal Amnioinfusion: Severe Oligohydramnios

Prelabor patients: Poor Utz visualization  
 Dx: anomalies, ROM, spontaneous oligo  
 Decisions for termination, C/S  
 Procedure: ~250 ml NaCl + indigo carmine  
 Withdraw fluid for chromosomes  
 Repeat Utz  
 Check for dye leakage

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## Transabdominal Amnioinfusion: Failed Version

Benifla et al, Ob & Gyn 1994  
 6 patients; 800 ml saline  
 Postinfusion version at 24 h  
 No randomized trials

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## Amnioinfusions: Questions

- Risks: Increased uterine tone,  
? amnionitis/endometritis
- Affect on labor: No change in length of labor
- VBAC: Use bolus only
- Solution: Saline or Ringers lactate
- Temperature: Room temperature or 37°C
- Catheter: double lumen catheter

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	Benefit
<b>Therapeutic Amnioinfusion</b>	
Variable decelerations with oligohydramnios	Yes
Variable decelerations with normal AF volume	Yes
Chorioamnionitis	?
<b>Prophylactic Amnioinfusion</b>	
Term oligohydramnios	No
Preterm premature rupture of membranes	?
Meconium	No
<b>Prelabor Transabdominal Amnioinfusion</b>	
Severe oligohydramnios	Yes
Failed version	?

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## Oligohydramnios: Maternal Hydration

- Maternal oral water hydration
- Kilpatrick et al, 1991:
  - Increased AFI in oligohydramnios patients
- Kilpatrick et al, 1993:
  - Increased AFI in normal women
- Flack et al, 1995:
  - Increased AFI in oligohydramnios patients
  - No change in fetal urine flow
- Maternal plasma composition normalizes

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## Maternal Hydration and DDAVP

- Maternal oral water hydration
- Maternal DDAVP to prevent diuresis
- Results in maternal plasma hypotonicity
- Fetal plasma hypotonicity
- Increased fetal urine flow
- Reduced fetal swallowing
- Increased amniotic fluid volume

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## Treatment of Human Oligohydramnios: Maternal DDAVP

- Ross et al, AJOG 1996
- Design: FDA IND study
  - 5 pregnant women with oligohydramnios at term
  - Oral water 20 ml/kg and IV DDAVP 2 ug
  - AFI measured at baseline, 8 h, 24 h
  - Control patients with oligo (n=5) observed for 8 hours with maintenance IV hydration

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## Plasma Osmolality/Na

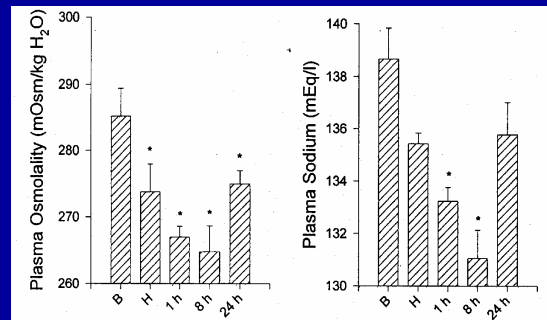


Fig. 1. Maternal plasma osmolality and sodium concentration during basal period (B), after hydration (H), and at 1 hour (1 h), 8 hours (8 h), and 24 hours (24 h) after hydration and dDAVP. Asterisk,  $p < 0.05$  versus basal values.

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## Amniotic Fluid Volume

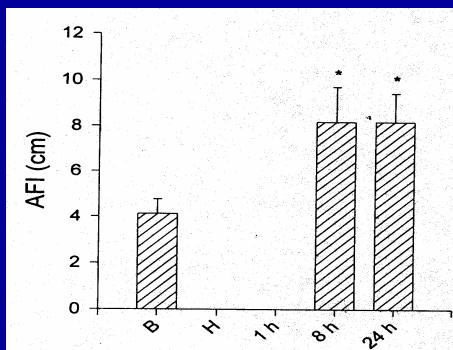


Fig. 3. Amniotic fluid index (AFI) during basal period (B) and at 8 hours (8 h) and 24 hours (24 h) after hydration and dDAVP. Asterisk,  $p < 0.05$  versus basal values.

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## Maternal DDAVP Results

- DDAVP patients
  - AFI 4.1 to 8.2 cm ( $p < 0.05$ )
  - 2 labor induction, 1 spontaneous labor following study
  - 2 discharged, delivered 4 and 8 days following study, no change in AFI
  - no newborn complications
- Control patients:
  - AFI no change (4.3 to 4.7 cm)

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## DDAVP: Questions and Concerns

- Effects on maternal and fetal blood volume
- Long term effects on AF volume
- Prophylactic or chronic use
- ? Mask oligohydramnios

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## Future Therapeutic Approaches

- Amniotic fluid volume
  - 3D ultrasound
- Oligohydramnios
  - Monitoring fetal urine flow
  - Repair of PROM
  - Maternal Hydration: DDAVP
- Polyhydramnios
  - Fetal endocrine therapy
  - Intraamniotic dDAVP

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