



Sugar Babies...

Effects of Diabetes on the Neonate,
Including Breastfeeding!

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Disclosures

I have nothing to disclose.



Outline

- Diabetes & the Neonate
- Diabetes & the Breastfeeding Dyad
 - Maternal
 - Infant
- Strategies to Improve Breastfeeding Success in Mother's with Diabetes



Maternal Diabetes & The Neonate



IDM: Complications

- Macrosomia
 - Perinatal asphyxia
 - Birth Injury (broken clavicle, broken humerus, Erbs Palsy)
- Small for Gestational Age
 - Hypoglycemia due to poor glycogen stores
- Hypoglycemia
 - Transplacental glucose supply is terminated
 - Plasma insulin levels remain high resulting in low blood glucose
- Hypocalcemia
- Hypomagnesemia

IDM: Complications

- Respiratory Distress
 - Respiratory Distress Syndrome
 - Due to immature fetal lung development and surfactant deficiency
 - Transient Tachypnea of the Newborn
 - Due to need for C/S due to macrosomia
 - Hypertrophic Cardiomyopathy/Septal Hypertrophy
 - Due to insulin-like growth factor and high glucose levels
- Poor Feeding
 - Relatively discoordinated suck and swallow
 - Lack of endurance outside of prior h/o respiratory distress

IDM: Complications

- Polycythemia
- Hyperbilirubinemia
- Renal Venous Thrombosis
 - Likely due to hyperviscosity, hypotension, DIC

IDM: Complications

- Congenital Malformations
 - Cardiac Defects
 - TGA, VSD, ASD
 - Renal Defects
 - Renal agenesis
 - GI Tract Defects
 - Small left colon syndrome, situs inversus

IDM: Complications

- Congenital Malformations
 - Neurologic Defects
 - Anencephaly, meningocele
 - Skeletal Defects
 - Hemivertebrae, Caudal Regression Syndrome
 - Unusual Facies
 - Microphthalmos

Maternal Diabetes & the Breastfeeding Dyad

Maternal



Maternal Benefits of Breastfeeding

- Increased interval between births (lactational amenorrhea)
- Decreased post-partum bleeding
- More rapid uterine involution (increased oxytocin)
- Earlier return to prepregnancy weight
- Decreased risk of breast CA, ovarian CA

Maternal Benefits of Breastfeeding

- Possibly decreased risk of hip fractures and osteoporosis when postmenopausal
- Increased self confidence in mothering abilities/contribution to preterm's care
- In GDM mom's decreased risk for later Type II DM
- Decreased RA & CV disease (HTN, Hyperlipid, per WHI)

Diabetes, Breastfeeding & The Non-Diabetic Mother

- All Mothers

- Decrease risk of obesity by 1% for each 6 mos of nursing
 - (Bobrow, KL, et al., Int'l Journal of Obesity 2013 May;37(5):712-7.)
 - CARDIA (Coronary Artery Risk Development in Young Adults) study of women ages 18-30w/o diabetes at baseline found that lactation duration is independently associated with lower incidence of diabetes.
 - (Gunderson, EP, et al., JAMA Intern Med. 2018 Mar 1;178(3):328-337.)

- Non-Diabetic Mother

- Decreased incidence of diabetes by 14-15% for each year BF
 - (Stuebe, AM, et al, JAMA, 2005,294(20):2601-2610, Duration of lactation and incidence of type 2 diabetes)

Breastfeeding & The Diabetic Mother

- Diabetic Mother
 - Decreased insulin need
 - Due to sugars in maternal blood being transferred to BM to meet infant's needs
 - 36% lower basal insulin requirement was thought to be caused by glucose use for milk production.
 - (Riviello, C, et al., Breastfeeding and the basal insulin requirement in type I diabetic women. Endocr Pract. 2009;15:187-193.)
 - Unclear if benefit to likelihood of development of long standing diabetes in GDM mother, some studies with decreased type II DM
 - Weight Loss/decrease obesity

Breastfeeding & Insulin

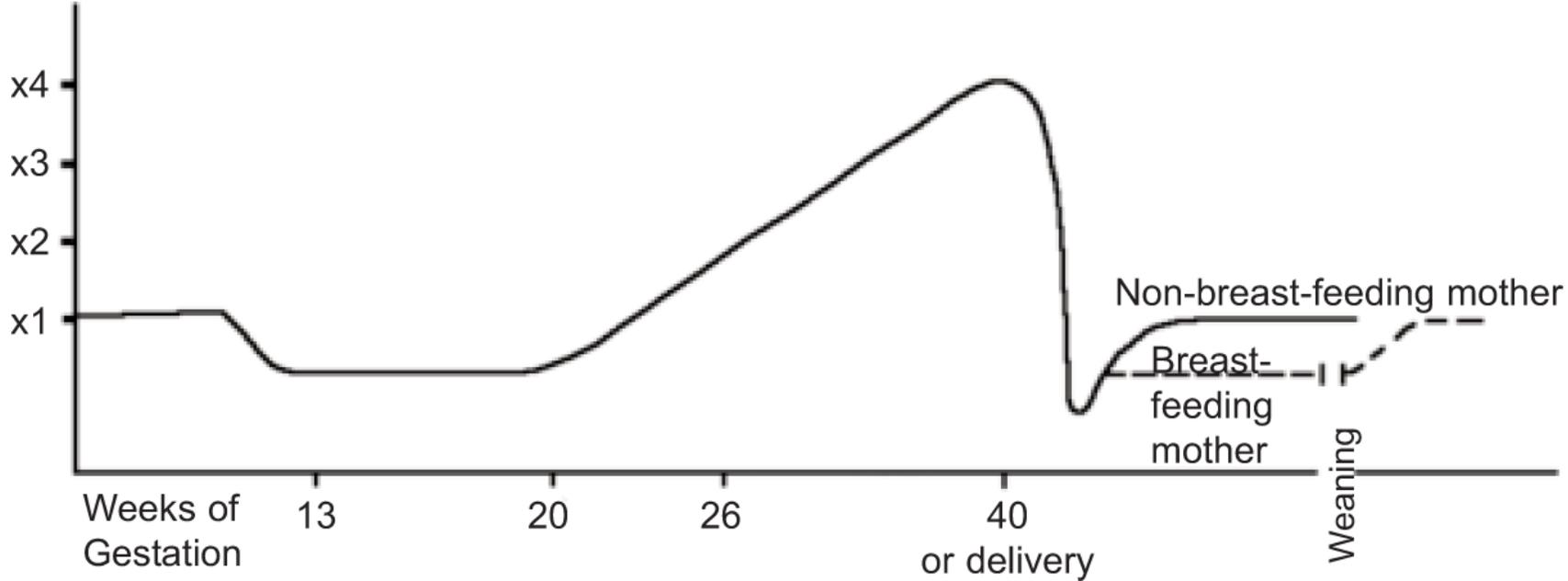
- Insulin requirements are reduced postpartum in women with type 1 diabetes.
 - (Ringholm L, et al., Managing type I diabetes mellitus in pregnancy-from planning to breastfeeding. Nat Rev Endocrinol. 2012;8:259-67.)
- Stanley study:
 - Insulin requirements were lower than prepregnancy dosage.
 - During the first week postpartum:
 - 54% of prepregnancy dosage on day 2
 - 73% on day 3 postpartum
 - On day 7 postpartum, insulin dosage returned to prepregnancy requirements.
 - (Stanley,K. et al, Physiological changes in insulin resistance in human pregnancy: longitudinal study with the hyperinsulinaemic euglycemia clamp technique. Br J Obstet Gynaecol. 1998; 105:756-9.)

Breastfeeding & Insulin

- Additional study, dosage requirements did not return to normal for up to 6 weeks in some mothers.
 - (Davies, HA, et al., Insulin requirements of diabetic women who breast feed. BMJ. 1989;289:1357-8.)
- A third study found that at 4 months postpartum, patients with type 1 diabetes who exclusively breastfed had an average of 13% lower insulin requirement than their prepregnancy requirement.
 - (Stage, E. et al., Long-term breastfeeding in women with type I diabetes . Diabetes Care. 2006;29:771-4.)

Breastfeeding Insulin

INSULIN REQUIREMENTS DURING PREGNANCY¹⁴



Diabetes Control & Breastfeeding

- Normal insulin levels are necessary for lactation.
 - (Benz, J. et al., The galactopharmacopedia. Antidiabetic agents and lactation. J Human Lact. 1992,8:27-8.)
- Appropriate glycemic control increases maternal serum and milk prolactin concentrations
 - Critical for the onset of lactation mitigating the delay that occurs in diabetic mothers
 - (Neubauer, SH et al., Delayed lactogenesis in women with insulin-dependent diabetes mellitus. Am J Clin Nutr. 1993;58(1):54-60.)
 - Ostrom, KM, et al., Prolactin concentrations in serum milk and milk of mothers with and without insulin dependent diabetes mellitus. Am J Clin Nutr. 1993;58(1):49-53.

Pituitary releases prolactin and oxytocin.

Stimulation of nerve endings in mother's nipple/areola sends signal to mother's hypothalamus/pituitary.



Hormones travel via bloodstream to mammary gland to stimulate milk production and milk ejection reflex (let-down).

Infant suckles at the breast.

Diabetes and Challenges with Breastfeeding

- Later onset of lactation in patients with type 1 diabetes than nondiabetic women
 - Greater delay in mothers with poor glucose control.
 - (Stanley,K. et al, Physiological changes in insulin resistance in human pregnancy: longitudinal study with the hyperinsulinaemic euglycemia clamp technique. Br J Obstet Gynaecol. 1998; 105:756-9.)
 - (Neubauer, SH, et al., Delayed lactogenesis in women with insulin-dependent diabetes mellitus. Am J Clin Nutr. 1993;58(1):54-60 .)
- Mothers with type 1 diabetes also discontinue nursing at a higher rate during the first week postpartum.
 - (Ferris AM, et al., Lactation outcome in insulin-dependent diabetic women. J Am Diet Assoc. 1988;88(3):317-22).
 - (Hummel S, et al., Breastfeeding habits in families with type I diabetes. Diabet Med. 2007;24:671-6.)
 - (Finkelstein SA, et al., Breastfeeding in women with diabetes: lower rates despite greater rewards. A population based study. Diabet Med. 2013;30:1094-101.)

Diabetes and Challenges with Breastfeeding

- Duration of lactation if established is the same in mothers with diabetes as in mothers without diabetes.
 - (Neubauer, SH, et al., Delayed lactogenesis in women with insulin-dependent diabetes mellitus. Am J Clin Nutr. 1993;58(1):54-60 .)
 - (Schoen S, et al., Breastfeeding duration in families with type I diabetes compared to non-affected families from BABYDIAB and DONALD studies in Germany. Breastfeed Med. 2008;3:171-5.)
- GDM mothers treated with insulin have a delayed onset of lactogenesis II compared to those not treated with insulin.
 - (Matias SL, et al., Maternal prepregnancy obesity and insulin treatment during pregnancy are independently associated with delayed lactogenesis in women with recent gestational diabetes mellitus. Am J Clin Nutr. 2014;99:115-21.)

GDM and Challenges with Breastfeeding

- Duration of lactation is shorter in mothers with GDM compared to mothers without diabetes.
 - (Nguyen, PTH, et. Al., Gestational Diabetes Mellitus Reduces Breastfeeding Duration: A Prospective Cohort Study. Breastfeed Med. 2019 Jan/Feb; 14(1):39-45.)
- Specific Barriers to Breastfeeding in GDM mothers include differences in breastfeeding-related knowledge, attitudes, beliefs, and experiences with GDM mothers less comfortable and knowledgeable about breastfeeding
 - (Doughty, KN, et al., Barriers to Exclusive Breastfeeding Among Women With Gestational Diabetes Mellitus in the United States. J Obstet Gynecol Neonatal Nurs. 2018 May;47(3):301-315.)

GDM and Challenges with Breastfeeding

- In-Hospital Breastfeeding Experiences Differ Between mother with or without GDM. With GDM mothers:
 - Less likely to report breastfeeding in the first hour
 - Less likely to feed only breastmilk in the hospital
 - Feeding on demand
 - More likely to receive a pump and a formula gift pack.
- (Oza-Frank, R, et al., In-Hospital Breastfeeding Experiences Among Women With Gestational Diabetes. Breastfeed Med. 2017 Jun; 12:261-268.)

Maternal Diabetes & the Breastfeeding Dyad

Infant



Benefits of Breastfeeding, Infant

TABLE 2 Dose-Response Benefits of Breastfeeding^a

Condition	% Lower Risk ^b	Breastfeeding	Comments	OR ^c	95% CI
Otitis media ¹³	23	Any	—	0.77	0.64–0.91
Otitis media ¹³	50	≥3 or 6 mo	Exclusive BF	0.50	0.36–0.70
Recurrent otitis media ¹⁵	77	Exclusive BF ≥6 mo ^d	Compared with BF 4 to <6 mo ^d	1.95	1.06–3.59
Upper respiratory tract infection ¹⁷	63	>6 mo	Exclusive BF	0.30	0.18–0.74
Lower respiratory tract infection ¹³	72	≥4 mo	Exclusive BF	0.28	0.14–0.54
Lower respiratory tract infection ¹⁵	77	Exclusive BF ≥6 mo ^d	Compared with BF 4 to <6 mo ^d	4.27	1.27–14.35
Asthma ¹³	40	≥3 mo	Atopic family history	0.60	0.43–0.82
Asthma ¹³	26	≥3 mo	No atopic family history	0.74	0.6–0.92
RSV bronchiolitis ¹⁶	74	>4 mo	—	0.26	0.074–0.9
NEC ¹⁹	77	NICU stay	Preterm infants Exclusive HM	0.23	0.51–0.94
Atopic dermatitis ²⁷	27	>3 mo	Exclusive BFnegative family history	0.84	0.59–1.19
Atopic dermatitis ²⁷	42	>3 mo	Exclusive BFpositive family history	0.58	0.41–0.92
Gastroenteritis ^{13,14}	64	Any	—	0.36	0.32–0.40
Inflammatory bowel disease ³²	31	Any	—	0.69	0.51–0.94
Obesity ¹³	24	Any	—	0.76	0.67–0.86
Celiac disease ³¹	52	>2 mo	Gluten exposure when BF	0.48	0.40–0.89
Type 1 diabetes ^{13,42}	30	>3 mo	Exclusive BF	0.71	0.54–0.93
Type 2 diabetes ^{13,43}	40	Any	—	0.61	0.44–0.85
Leukemia (ALL) ^{13,46}	20	>6 mo	—	0.80	0.71–0.91
Leukemia (AML) ^{13,45}	15	>6 mo	—	0.85	0.73–0.98
SIDS ¹³	36	Any >1 mo	—	0.64	0.57–0.81

ALL, acute lymphocytic leukemia; AML, acute myelogenous leukemia; BF, breastfeeding; HM, human milk; RSV, respiratory syncytial virus.

^a Pooled data.

^b % lower risk refers to lower risk while BF compared with feeding commercial infant formula or referent group specified.

^c OR expressed as increase risk for commercial formula feeding.

^d Referent group is exclusive BF ≥6 months.

Infant Benefits of Breastmilk/Breastfeeding

- Species Specific
- Gold standard for growth, health and development
- Decreased postneonatal infant mortality rates (21% in US)
- Promotes mother-infant attachment

IDM: Benefits of Breastfeeding

- Decreased Obesity & Diabetes...
 - Insulin is a normal component of BM
 - Insulin promotes gut maturation and reduces intestinal permeability to macromolecules
 - May induce tolerance to insulin protecting from type 1 diabetes
 - (Shehadeh N, et al., Insulin in human milk and the prevention of type I diabetes. *Pediatr Diabetes* 2001;2(4):175-7.)
 - (Shehadeh N, et al., Importance of Insulin content in infant diet:suggestion for new infant formula. *Acta Paediatr.*, 2001;90:93-5.)

IDM: Benefits of Breastfeeding

- Decreased Diabetes when breastfed
 - 30% for Type I
 - 40% for Type II
 - (AAP Breastfeeding and the Use of Human Milk, Pediatrics; 129(3):827-841.)
- Colostrum stabilizes infant blood glucose (enhances gluconeogenesis)
 - (Eidelman, AI, Hypoglycemia and the breastfed neonate. Pediatr Clin of North Am. 2001 Apr; 48(2):377-87.)

- Strategies For Breastfeeding Success in Diabetic Mothers



Supporting the Diabetic Mother-Infant Dyad

- Prenatal Education on risks of poor glucose control
- Optimize blood glucose control prenatally
 - Especially in the days and hours prior to delivery
- Pumping prior to delivery...DAME study
- Minimize separation
 - Hand expression, spoon feeding
 - Colostrum
 - Glucose gel
 - Formula vs. BBM supplementation

DAME Study

Diabetes and Antenatal Milk Expressing Trial

- Multi-centre (6 hospitals)
- Unblinded, Randomised Controlled Trial
- Women with pre-existing or gestational Diabetes in a singleton pregnancy at 34-37wks GA
- Randomized to
 - Standard care
 - Hand expression 2x/days
- Primary Outcome:
 - Proportion of infants admitted to the NICU

DAME Study

Diabetes and Antenatal Milk Expressing Trial

- Results:
- 635 women
 - 319 Intervention
 - 316 Standard Care
- 15% vs. 14% of infants admitted to NICU
- Adverse events:
 - Intervention: <1% need for NICU admit for resp. Sx
 - Control: <1 % modt or severe encephalopathy
- Conclusion: No harm in advising women at low risk to express starting at 36wks

Supporting the Diabetic Mother-Infant Dyad

- Lactation Support
 - Pumping if supplementation
 - Pumping if infant complications interfering with direct breastfeeding
- Defining Expectations
 - May have delayed increase in milk volumes possibly to day 7-10
 - Educate role of supplementation
- Common Diabetic Medications and Breastfeeding
 - Utilize an appropriate resource to evaluate safety and breastfeeding

Supporting the Diabetic Mother-Infant Dyad

- If supplement
 - What to supplement with?
 - Continued pumping any time the infant is receiving supplement
 - Plan to wean off supplement if unable to discontinue supplement during birth hospitalization
- Discharge/Outpatient
 - Plan for lactation follow up
 - Access to a high quality pump at home
 - Close monitoring of infant intake and maternal milk production
 - Continued pumping

QUESTIONS?



LONG LIVE CHILDHOOD

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