

RD's In Practice: Advancing Pediatric Nutrition

A Strong Beginning

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Objectives

- Understand the challenges associated with the ELBW/VLBW infant, including the nutritional management principles for the first 10 days of life.
- Understand the key elements to provide aggressive nutrition support to the ELBW/VLBW infant in the first 30 days of life.

Overview

- Demographics
- Fluid Management
- Importance of Early Nutrition
 - EUGR
 - Parenteral Nutrition
 - Intestinal Readiness

Demographics

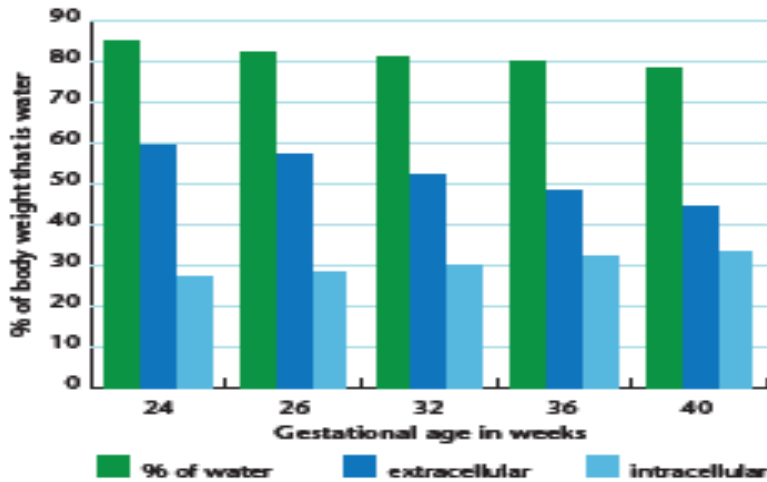
- In California each year ~560,000 live births
 - 58,000 preterm births (11%)
 - 8,500 very preterm (1.5%)
 - 4,000 extremely preterm (0.7%)

ELBW Data

<u>GA</u>	<u>Survival</u>	w/o morbidity
22	6%	0%
23	26%	8%
24	55%	9%
25	72%	20%
26	84%	34%
27	88%	44%

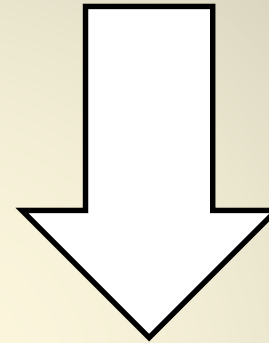
Fluid Management Considerations

FIGURE 1 ■ Changes in fetal body water composition during gestation.



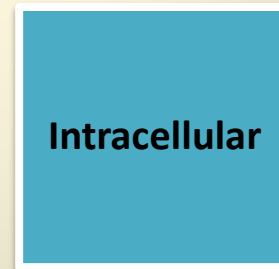
Adapted from: Friis-Hansen, B. (1957). Changes in body water compartments during growth. *Acta Paediatrica*, 6(Suppl. 110), 1-68; and Friis-Hansen, B. (1961). Body water compartments in children: Changes during growth and related changes in body composition. *Paediatrics*, 28, 169-181.

Body Water Composition



Extracellular

- Intravascular
- Interstitial



Intracellular

Excess
fluid
shed

**Allow for necessary fluid
contraction**

Goals in Fluid Management



- Allow for ECF Contraction
 - Balance fluid needs Vs fluid losses
- Goal Fluids at birth – 80ml/kg/day
- Adjust by 10ml/kg/day increments
- By the first week we are usually not on any more than 130ml/kg/day.

Umbilical Lines



- Rarely need double lumen UVC
 - More mechanical issues
 - Increased non-nutritional fluids
- Not every baby needs a UAC
- UAC increases non-nutritional fluids (12ml/day)
 - 500 g = 24ml/kg/day
 - 1000 g = 12ml/kg/day
- UAC fluids

Importance of Early Nutrition

- No stored fetal reserves
- Avoid “metabolic shock”
 - Baby is immediately catabolic with increased protein needs
 - Huge demand for CNS growth
- Prevention of postnatal growth restriction – begins at birth



Nutrition Goals – Prevent Postnatal Growth Restriction

- AAP States Nutritional Goal of growth approximating normal fetus (Kleinman 2009, AAP)
- If parallel in utero growth is the goal, we will fail
 - Postnatal growth of AGA 26 week infant regaining BW by 2 weeks of age growing at fetal rate = body weight fall from 50% to 10%



Importance of Early Nutrition

- Extruterine growth restriction (EUGR) in NICU premature infants is estimated at 90% Martin CR, et al. *Pediatrics*, 2009; Carlson & Ziegler, 1998; Ehrenkranz 2000; Ehrenkranz et al., 1999; Embleton et al., 2001; Radmacher et al., 2003; Clark et al., 2003
- 30-40% are still growth restricted at 18-22 months Bloom et al., 2003, Clark et al., 2003

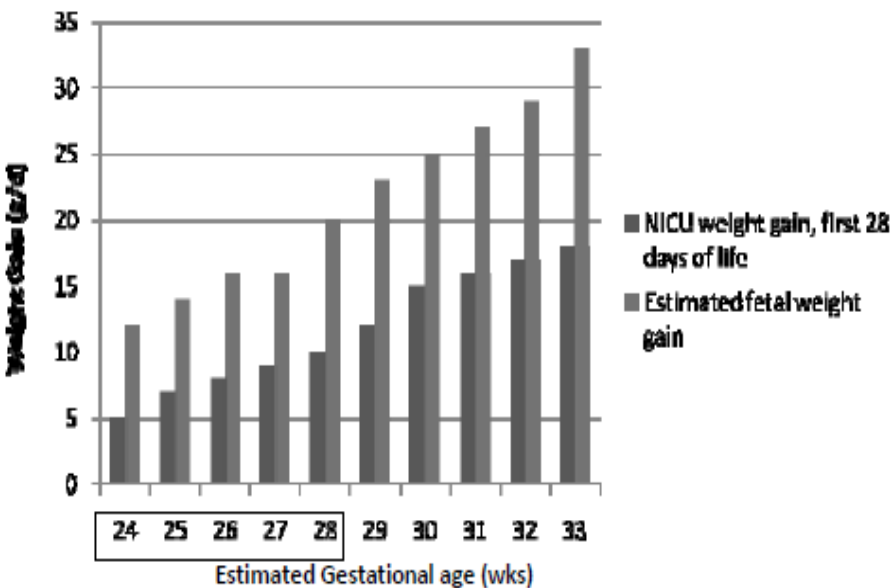


Nutrition Goals – Prevent Postnatal Growth Restriction

- Inadequate nutrition appears to be the predominant cause of growth failure (Ziegler et al., 2007)
- Inadequate nutrition causing growth failure has neuro-developmental consequences (Morley, 1999; Ziegler et al., 2007; Neubauer et al., 2008; Bolduc & Shevell, 2005; Cooke & Foulder-Hughes, 2003; Cooke, 2006; Gale et al., 2006)

EUGR

Extrauterine Growth vs. Intrauterine Growth



Clark, R.H. et al Jnl of Perinatology 2003 23:337-344

Poor Neurodevelopmental Outcomes

Outcomes at 18 to 22 Months Corrected Age According to Weight Gain Quartile

Outcome	Quartile 1 N=124	Quartile 2 N=122	Quartile 3 N=123	Quartile 4 N=121	P value
Weight gain g/kg/d	12.0	15.6	17.8	21.2	
CP %	21	13	13	6	<0.01
MDI <70, %	39	37	34	21	<0.01
PDI <70, %	35	32	18	14	<0.01
NDI, %	55	49	41	29	<0.01
Rehospitalization	63	60	50	45	<0.01

Ehrenkranz, R.A. et al Pediatrics 2006 117:1253-1261

Poor Neurodevelopmental Outcomes

Outcomes at 18 to 22 Months Corrected Age According to Head Circumference Quartile

Outcome	Quartile 1 N=124	Quartile 2 N=122	Quartile 3 N=123	Quartile 4 N=121	P value
Rate of HC growth cm/week	0.67	0.87	0.98	1.17	
CP %	22	17	11	3	<0.01
MDI <70, %	44	41	23	22	<0.01
PDI <70, %	43	29	12	17	<0.01
NDI, %	62	51	33	28	<0.01
HC <10percentile, %	35	18	20	16	<0.01

Ehrenkranz, R.A. et al Pediatrics 2006 117:1253-1261

Parenteral Nutrition

- Carbohydrate (Glucose)
 - Goal delivery 4-8g/kg/day first days
 - Should be infusing by 1 hour of life

- Protein
 - Needed for growth and prevention of poor neurodevelopmental outcomes (Ehrenkranz 2007; Valentine et al 2009)
 - Lose stores if not administered – goal of 3gm/kg/day (Denne 2007)



Parenteral Nutrition

- Intralipid
 - Prevention of EFA deficiency
 - Myelination



Importance of early nutrition

- Early parenteral nutrition ALONE, does little for the development of the GI tract function
- Fetal swallowed amniotic fluid has a developmental affect on GI tract structural and functional integrity
- Enteral feeds (trophic feeds) have direct effects on the GI tract and indirect effects by the release of intestinal hormones

Trophic Feeds – What's the Evidence

- Improves feeding tolerance
- Stimulates gut motility and maturity
- Shortens time to full feeds
- Decreases LOS
- Does not increase risk of NEC



(CPQCC/CAN; McClure, 2000; Peter, et al, 2002; Ziegler, 2002; Kuzman-O'Reilly, 2003; Berseth; Yu, et al, 2005; Tyson & Kennedy Cochrane Review 2005)

Enteral Nutrition



- Breast Milk
- Use of Standardized Feeding Guidelines
 - Less Variability
 - Reduced risk of NEC
 - Achieves full feeding volumes earlier

CPQCC/CAN; Kamitsuka 2000 Peter, et al, 2002; Ziegler, 2002; Kuzman-O'Reilly, 2003; Berseth; Patole 2005 Yu, et al, 2005; Street 2006

Colostrum Swabs

- Colostrum
 - Contains growth factors & cytokines
- Oropharyngeal swabs
 - Anti-infective – mucosal absorption of Secretory IgA & Lactoferrin interfere with colonization
 - Activation of immuno-modulation
- Parental Involvement



Gastric Residual

- What does the evidence show?
 - Gastric residual alone does not indicate feeding intolerance
 - First few days of life gastric residuals are common
 - In the absence of clinical change, gastric residuals
 - >2ml for BW < 750 grams
 - >3ml for BW 751-1000 grams
 - Green (non-bilious)
 - Isolated findings related to gastric emptying should not alter feedings (Mihatsch 2002, Jadcherla 2002, CPQCC)
- A plan for *consistently* addressing residuals

Fetal Brain Development



23 weeks gestation

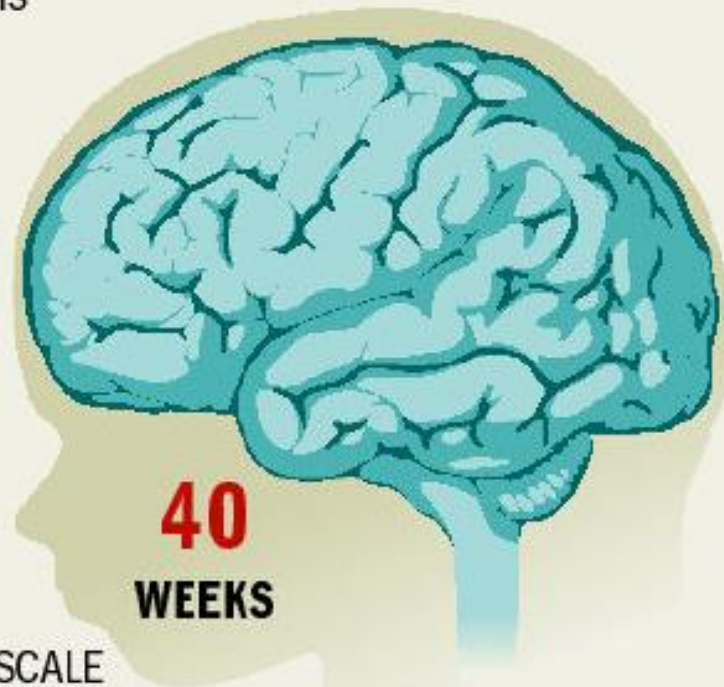


40 weeks gestation

Brain Growth

Bigger is better

A baby's brain at 35 weeks weighs only two-thirds what it will weigh at 40 weeks.



Source: March of Dimes

ELBW Admission Order Set

Orders Medication List

+ Add Document Medication by Hx

Orders Medication List

View

- Orders for Signature
- Plans
 - Medical
 - NICU Admit ELBW Order Set (Planned Pending)
 - NICU Admit ELBW Order Set (Initiated)**
 - Orders
 - Admission
 - Condition
 - Vital Signs
 - Activity
 - Nursing Orders
 - Diet
 - Continuous Infusions
 - Medications
 - Respiratory
 - Diagnostic Tests
 - Laboratory
 - Consults
 - Rehab
 - Discharge Planning
 - Nursing Practice
 - Central Service
 - Non Categorized
 - Medical Supplies
 - Medication History
 - Reconciliation History

Offset Add to Phase Start: Now Duration: None

Offset	Component	Status	Details
Nursing Orders			
<input checked="" type="checkbox"/>	Daily Weights		BEDTIME
<input checked="" type="checkbox"/>	Length (Measure Length)		BEDTIME Su
<input checked="" type="checkbox"/>	Head Circumference		BEDTIME Su
<input checked="" type="checkbox"/>	Accurate I&O		
<input checked="" type="checkbox"/>	Blood Glucose Monitoring (Glucose Level at Bedside)		SEE NOTE, Note: Per Nursing Procedure
<input checked="" type="checkbox"/>	Transduce Arterial Line		Special Instructions: UVC
<input type="checkbox"/>	Transduce Central Line		
<input type="checkbox"/>	NG Tube		Low Intermittent suction
<input type="checkbox"/>	Notify MD		
Diet			
<input checked="" type="checkbox"/>	NPO		
Continuous Infusions			
<input checked="" type="checkbox"/>	***Usual starting Dextrose for ≥ 26 weeks gestational age = 10%*** D10W		IV, Begin Routine, Special Instructions: to be run at current TPN rate for 3h p...
<input type="checkbox"/>	D10W + Trophamine 3.5% + CaGluc 2 mg/mL + hep 0.5 units/mL		IV, Begin Routine
<input type="checkbox"/>	D10W + Trophamine 3.5% + CaGluc 2 mg/mL		IV, Begin Routine
<input type="checkbox"/>	***Usual starting Dextrose for < 26 weeks gestational age = 5%*** D5W + Trophamine 3.5% + CaGluc 2 mg/mL + hep 0.5 units/mL		IV, Begin Routine
<input type="checkbox"/>	D5W + Trophamine 3.5% + CaGluc 2 mg/mL		IV, Begin Routine
<input type="checkbox"/>	See TPN Order Sheet		
UAC Line			
<input type="checkbox"/>	sodium ACETATE 0.63% (Na = 77 mEq/L) + hep 0.5 Units/mL		500 mL 0.5 mL/hr IV, Begin STAT, Special Instructions: UAC
UVC Line			
<input type="checkbox"/>	1/2 NS + hep 0.5 units/mL		500 mL 0.5 mL/hr IV, Begin STAT, Special Instructions: UVC, -1, HRS
Medications			
<input type="checkbox"/>	poractant		2.5 mL/kg ETT ONE TIME, Dosing Guidelines: Initial dose
Antibiotics			
<input type="checkbox"/>	ampicillin		50 mg/kg IV q12h STAT Dosing

A**NICU Feeding Guideline/Schedule A****Birth Weight \leq 750 grams**

Date	Line/ Day	Weight (kg)*	ml/kg/ day		#Fdgs	ml/Fdg/ Q3
	1	X	10		÷ 8	=
	2	X	10		÷ 8	=
	3	X	10		÷ 8	=
	4	X	10		÷ 8	=
	5	X	10		÷ 8	=
	6	X	20		÷ 8	=
	7	X	30		÷ 8	=
	8	X	40		÷ 8	=
	9	X	50		÷ 8	=
	10	X	60	22cal #	÷ 8	=
	11	X	70	Infuse feeds over 1 hr [^]	÷ 8	=
	12	X	80	24cal #	÷ 8	=
	13	X	90		÷ 8	=
	14	X	100		÷ 8	=
	15	X	110	Remove Central Line	÷ 8	=
	16	X	120		÷ 8	=
	17	X	130		÷ 8	=
	18	X	140		÷ 8	=
	19	X	150		÷ 8	=

Intolerance Algorithm

Nonbilious Residual 50%
of feeding with Normal Exam
(Abnormal Exam requires immediate MD notification)

1st Occurrence

Return residual
Feed full volume

Consider

- Positioning: Prone or Left Lateral
- Stool last 24 hr. - ?microenema

2nd Consecutive
Occurrence

Notify MD Immediately

Consider

- Continue same feedings
- Return residual and give full feeding
- Return residual & subtract from feeding volume
 - Hold feeding advance
- Return residual and hold current feeding***
 - Hold current feeding***

***Anytime a feeding is held – reevaluate at the next scheduled feeding time for:

- Restart same feedings
- Reduce feeding volume by 20%
- If multiple feedings held, can feedings be restarted @ 10-20ml/kg/d
- Must obtain MD order for IV rate adjustment

Thank you

