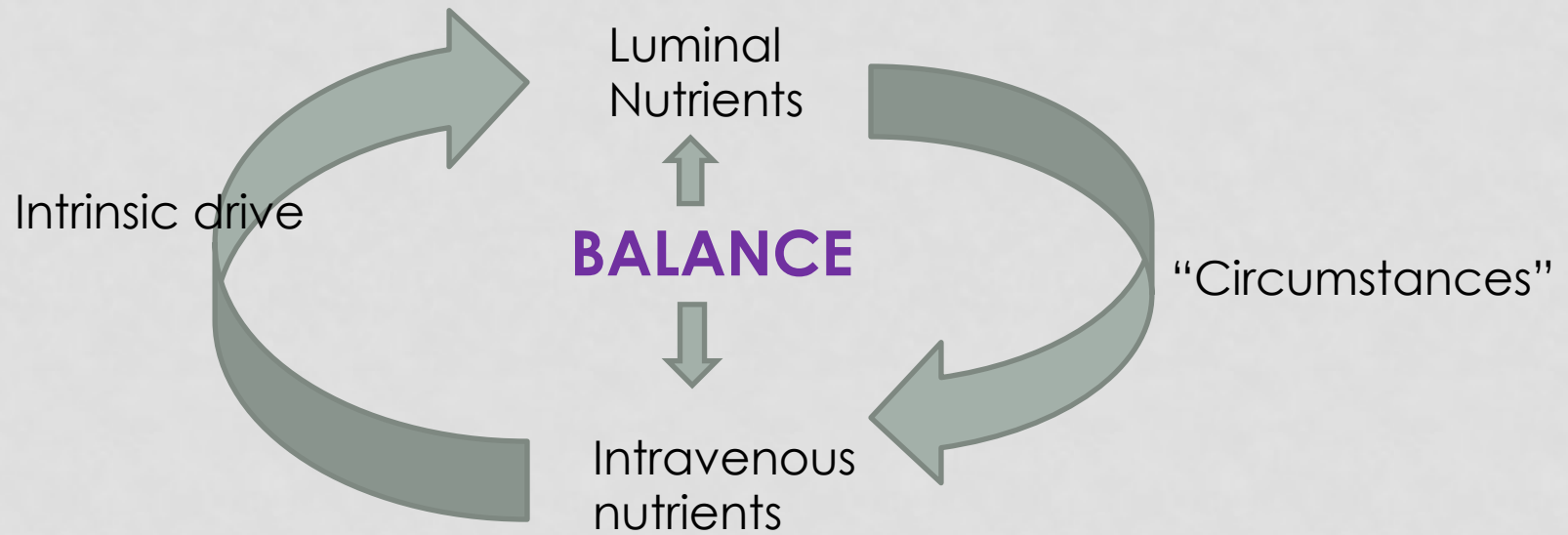


# BALANCING THERAPIES

ENTERAL AND PARENTERAL



# FINDING BALANCE

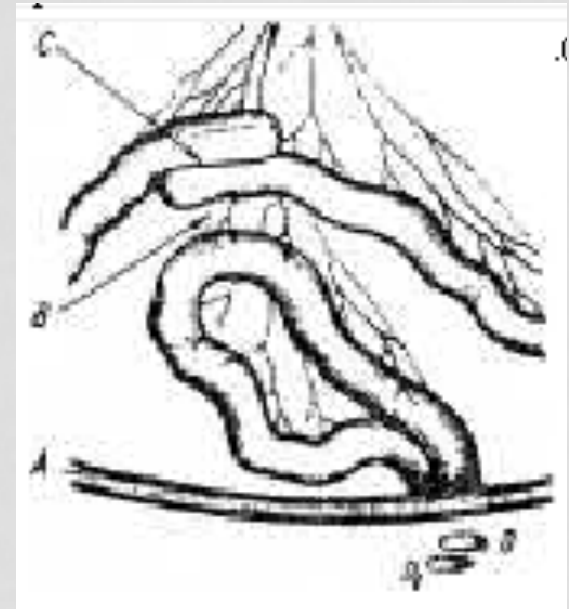
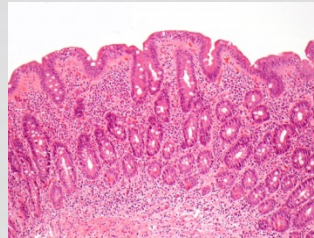


# OBJECTIVES

- Why focus on adding enteral nutrients?
  - Benefits the patient even before energy provision
  - Provide a mechanism for patient and family to actively participate in process of adaptation
  - Endgame in pediatrics is to convert to complete enteral nutrition
- How to introduce and escalate enteral therapy
  - Basic principles from the pediatric perspective
  - Transition from hospital to home and keep the momentum
  - Anticipate and negotiate obstacles

# EFFECTS OF ENTERAL STIMULATION ON MUCOSAL INTEGRITY

- Lesson from Thiry-Vella loops
- Loops of intestine- non-connected exert positive influence on each other



<http://library.med.utah.edu/WebPath/GIHTML/GI162.html>

<http://newsroom.cumc.columbia.edu/blog/2013/08/05/celiac-disease-patients-with-ongoing-intestine-damage-at-lymphoma-risk/>

# THE INTESTINAL BARRIER

- Healthy villi and microvilli = surface area for contact with nutrients
- Healthy goblet cells = a protective mucus layer
- Biologic nutrient solutions have WBC's, antibodies (IgA) and other substances to create an immune barrier.
- Motile intestines transport the slurry of nutrients and our microflora – stasis is the enemy 😊

# OTHER CONSIDERATIONS

- Gastric benefits –
  - Maintain gastric acid barrier to limit pathogens
- Liver and pancreatic stimulation
  - supports bile flow and pancreatic enzyme elaboration
- Normal GI hormone elaboration  
Completes the neuro-enteric interactions/ Gastro-colic reflex, motility, hunger/satiety

# EVEN IF ADAPTATION IS NOT A CONSIDERATION

- Examples of combining therapies to improve outcomes
  - “Balanced anesthesia” – iv drugs + inhaled agents + locally active agents (regional anesthesia)
  - Treatment of cancer – smaller doses of each drug in combination with other drugs and modalities (rad Tx, surgery) yields improved outcomes
  - Transplant Immunosuppression

# SUSTAIN DATABASE

- Dramatic divergence between adult and pediatric patients in terms of use of enteral nutrition (specifically tube feedings)
- Virtually none in adults vs. 60%
- WHY?



# ADULT

- Different disease spectrum –
  - Maybe not amenable to large volume enteral.
  - Focus is on sustaining rather than transitioning.
  - Volume repletion >> nutrient repletion (ORS) 15% vs 5%
- Pleasure of eating vs. tube feeding
  - but still 25% adults NPO
- Different profile of adverse consequences of isolated HPN
- Limited use of low profile devices for enteral nutrition

# ENTERAL NUTRITION IN CHILDREN

- Profile of intestinal failure is different
- Many acquired disorders in preterm babies allow for ongoing longitudinal growth of the intestine in addition to the other compensatory changes that result in full adaptation.
- Even in term and older infants the potential for full adaptation is anticipated.
- Optimism reflected in recent JAMA publ from BCH

**Table 3. Study End Points**

Outcome	No. (%) of Patients	Length of Residual Small Intestine, cm	
		Mean (SD)	Median (IQR) [Range]
Weaned from PN	40 (63)	54.6 (26.7)	55.0 (28.0, 75.0) [12.0-100.0]
PN dependent	11 (17)	27.3 (14.9)	26.0 (14.0, 41.0) [5.0-50.0]
Died	8 (13)	27.8 (10.0)	26.0 (20.5, 35.0) [14.0-45.0]
Underwent transplant	4 (6)	34.9 (25.0)	36.0 (13.5, 56.2) [9.0-58.4]

# ENTERAL NUTRITION IN CHILDREN

- Management dictated by age of child
- Gastrostomy devices usually placed at time of original intervention
- We allow for sham feeds with foods that we may not otherwise subject the residual intestine to.
- Most neonates will develop oral aversion from
  - the support tubes we place.
  - the non-palatable formulas we offer .
  - absence of hunger to drive eating.
  - development of reflux esophagitis, vomiting

# PEDIATRIC PRINCIPLES

- push feeds to tolerance and carefully beyond to provide impetus for adaptation.
- Provide a safe environment with adequate supervision to monitor for volume loss, electrolyte derangements and dehydration
- Tolerance defined loosely but generally stoma output should not exceed 30% of volume of enteral intake, or no > 8 stools a day.
- Examine nature of output – reducing substances
- Re-feeding into distal stoma if accessible- or connect GI tract
- Once at a point where pushing has to slow down, consider transition to home. Ideally at >30% enteral nutrient supply.

# CASE EXAMPLE

- 8 day old term infant with intestinal infarct secondary to volvulus around mesenteric cyst
- Multiple laparotomies in first 5 days to salvage as much bowel = 40cm SB + entire colon. G-tube placed and primary anastomosis performed, TPN delivered via PICC line initially.
- Initial hyper-bilirubinemia resolved by 3 weeks and never recurred.
- Age 3 months ready for d/c home on TPN (broviac placed) and enteral feeds (PO/gavage daytime + continuous at night). EtoH lock, no other meds.

# CONTINUED

- Readmitted once with line infection (Klebsiella, Lactobacillus) 2d after initial d/c and finally home at age 4 months without readmissions.
- Very motivated, educated family – gave them parameters to achieve goals on weekly basis.
- Remainder of management completely outpatient with successful weaning off TPN by about 6 months of age.
- Now 18 months of age. Intermittent G-tube feeds

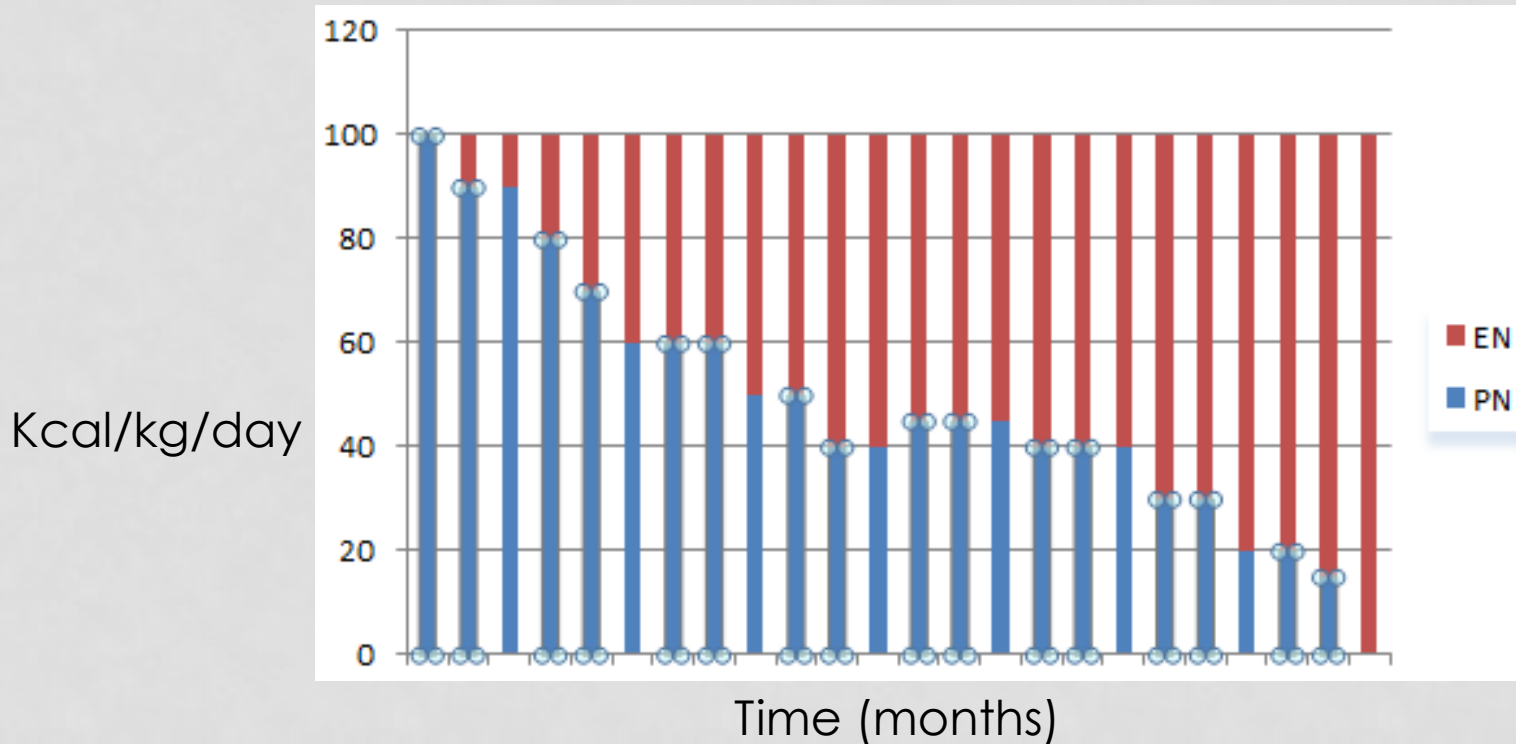
# HOW TO MONITOR AND KEEP TRACK

- Bedside growth charts
  - Track daily weight, weekly height
  - Labs
  - Volume of HPN – fluid & caloric delivery
  - Volume of enteral intake and caloric delivery
  - Proportion PN/EN.
- 
- Shows you when you can increase the proportion of enteral delivery
  - Assures that you keep cal/day normalized to weight





# PROJECTED CONVERSION



Compensate for changing kcal/kg/day needs as they get older, recover from operations, etc  
Total caloric intake will increase as they grow ---easy to misinterpret as going up on TPN

# WHEN YOU RUN INTO PROBLEMS

- Reflux compromising ability to increase feeds
- Excessively loose stools
- Behavioral issues

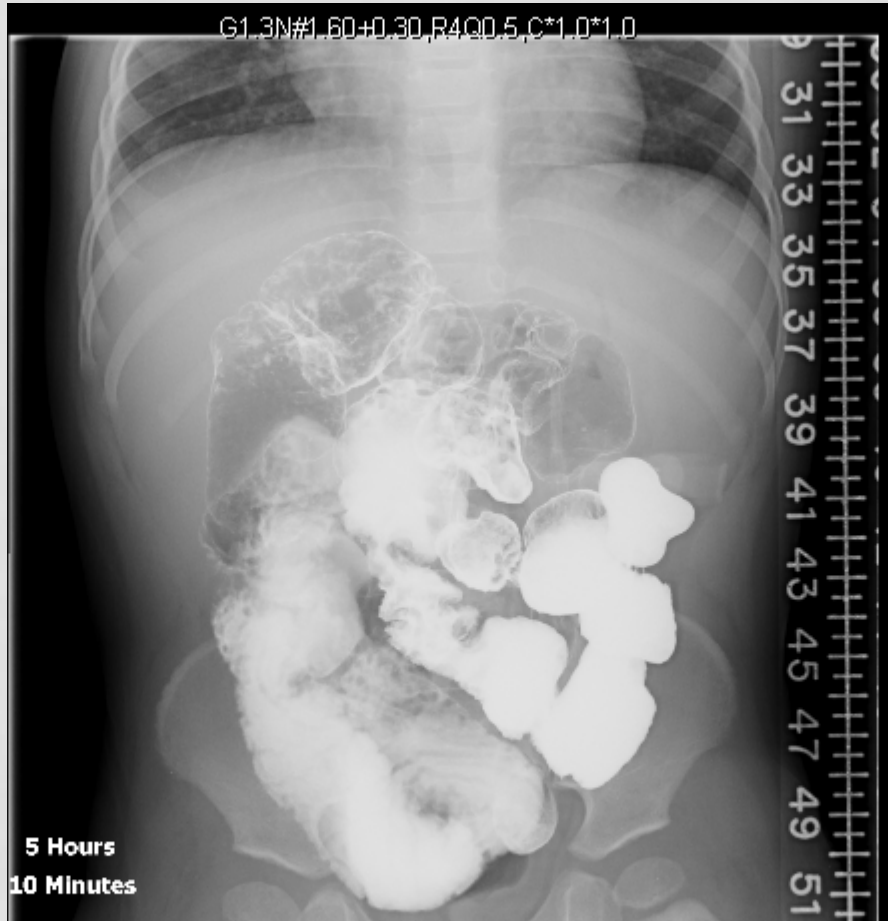
# REFLUX AND EMESIS

- Causes pain
  - Results in excessive use of antacid therapies
  - Leads to oral aversion
  - Leads to frustration with advancing feeds
  - Make sure it is not behavioral only.
- 
- Before you consider fundoplication
  - Consider placement of a GJ tube – in essence a thiry-vella loop.

# CASE EXAMPLE

- 12cm after midgut volvulus/gastroschisis – thought not to be candidate for full adaptation – faint hearted attempt at enteral feedings
- 14 mo Ex lap for SBO 48cm SB –Amazing! But emesis limits feeds.
- GJ placed
- Able to advance enteral - 40% caloric intake
- ? Fundoplication indicated
- Impedence study normal – focus on behavioral issues

# ROLE OF GJ TUBES



# REVERSE ENGINEERING OF GJ TUBES

- Three year old with limited adaptation now with dilation of distal SB segment before colonic anastomosis
- Wouldn't eat because he would have "reverse peristalsis" with large bilious emesis every am.
- Temporizing solution = GJ with G for feeding and J for drainage ( incomplete diversion)
- Resulted in decompression of dilated segment and return to more even dilated caliber
- Now to resume PO/ Gtube feeds without diversion vs. reconsider for tapering/lengthening procedure.

# LOOSE STOOLS

- Add fiber (i.e. green beans)
  - Improve colon health
  - Provide substrate for the microflora
- Mix complex nutrients with your basic formulas
  - Blenders are your friend
- Only when frequency >> volume – use lomotil type meds
- Be proactive with perianal care



# MAINTAIN AGENDA AND MOMENTUM

- Easier said than done at home
- But, home is so much better than hospital

# HOME CONSIDERATIONS

- So many pumps, IV poles, stuff for the refrigerator!
- TPN can be done overnight –
- Enteral feedings need to distribute over 24 hours – can't "hide" them all at night
  - Urine output would be excessive overnight – lack of sleep
- How do you travel with all this equipment?
  - How do they go to school?
- How do you give them some normalcy when they are with others who are not in same situation? (siblings, friends)

# WHO HELPS PAY FOR THIS?

- Pediatric patients
- SSI, Medicaid, commercial insurance and funding programs such as Katie Beckett in Rhode Island/SE Mass, WIC
- It becomes a balancing act with which one feels responsible ( or doesn't) for which component of care.

# OTHER THERAPIES

- Often need to work with OT/Speech/ Early intervention ( age<3yrs)
- Gaps in care when this care is not delivered as consistently on an outpatient basis as in the hospital
- Use resources in your own institution, but listen to results from parents using their own resourcefulness.

# SOMETIMES THE REVERSE OCCURS

- How to introduce TPN on a patient that has successfully weaned and needs to return to some HPN
- Psychologically a difficult situation - and it now impacts an older child who may not remember the early years and resents the new tether ( but the parents have not forgotten)
- This may become more of an issue as children go through growth spurts or don't make it through a growth spurt on the basis of inadequate nutrition

# A TALE OF TWO BROTHERS

- Gastroschisis – prenatal midgut loss = 40 cm with no ICV (right colon)
- TPN until 18months. Weaned after STEP procedure for bacterial overgrowth
- Did well- got rid of Gtube in another year
- Hyperphagic diet but terribly slow eater –his little brother finally surpassed him in height
- ? Candidate for growth hormone?
- Resumed TPN 3 days a week (weekend only) inserted a port instead of broviac- weaned to 2 days/week grew finally.

# STRATEGY

- Allow acute phase of illness to resolve and initiate enteral feedings as soon as safe from surgical standpoint
- Develop a long range plan (determine the daily caloric intake necessary to achieve goals) and keep adjusting this for ongoing weight gain
- Determine efficiency of the intestine – what is the x factor – it will change with adaptation
- With good education and documentation this can be done on outpatient basis

# LESSONS LEARNED

- Enteral feedings, even when minimal or involving only a portion of the gut, contribute to health of the patient
- This is accepted in the pediatric population because of the success with ultimate adaptation
- It is a cumbersome , resource intensive process, and must be customized to a patient's needs and goals
- By maintaining a healthy gut, even in the absence of adaptation, we should be able to decrease the morbidity associated with HPN ( sepsis and cholestasis)



