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Non-Shiga toxin Hemolytic Uremic Syndrome
Written Case Study

Subjective:
DS is a 22 month old male. He is edematous with abdominal distension. Diet history and from the parents and a chart review reveals that at home he had a "good appetite" and consumed a regular diet and whole milk from a bottle. He also consumed other liquids from a sippy cup and was learning how to use a fork and spoon. He experienced decreased oral intake with no vomiting for the past 3-4 days PTA and only tolerated Pedialyte and tea. PMH + for Thalassemia trait with baseline anemia and he was receiving an iron supplementation

Objective:
DS's nutrition-related diagnosis is sepsis, acute renal failure (ARF) secondary to possible Non-Shiga Toxin (NStx) Hemolytic uremic syndrome (HUS), and Left lower lobe (LLL) Streptococcus pneumonia (PNA). The nutritional significance is inadequate nutrient intake due to decreased appetite and increased protein needs due to protein losses in dialysis.

Hemolytic Uremic Syndrome (HUS) is a triad of microangiopathic hemolytic anemia, thrombocytopenia, and acute renal failure (ARF). It is the major cause of ARF in children younger than 3 years. There are two types of HUS, Shiga-toxin HUS and non-shiga toxin (NStx) HUS. NStx HUS accounts for only 10% of HUS cases. There is a high risk of death, disease recurrence, and/or chronic renal disease. Streptococcus pneumonia NStx HUS accounts for 40% of all causes of HUS in children. The bacteria produce toxins which destroy the red blood cells, platelets and clog the nephrons in the kidney. Microthrombi inhibit blood flow and destroy other vital organs such as the pancreas, liver, brain, kidney and heart. Typically in NStx HUS there is no diarrhea.

DS presented to ER on 3/14/08 with cough and fever. Chest X-Ray was negative and he was diagnosed with viral URI and sent home. Chest X-Ray later revealed LLL PNA. At home, he continued to have fevers and decrease in appetite with only liquids as po intake and decrease in urine output (~ 1 wet diaper per day) for 3-4 days. He was also lethargic and had diarrhea. Dad was sick with "flu" and 4 yr old sister sick with "asthma". DS returned to ER on 3/17 and the repeat CXR showed worsening PNA with effusion.

In the hospital, his diet order was NPO. Anthropometrics were as following:

- Weight: 13.8 kg, 83rd Percentile.
- Height/Length: 100 cm > 99th Percentile. Accuracy of the length was questioned due to a length of 85 cm obtained by the PMD in November, 2007.
- Head Circumference: 50 cm, 86th Percentile
- Ideal Body Weight: 15.7 kg (50th percentile weight/length)
- Weight/Length Percentile: 4th

- Body Mass Index: N/A (only used for children ≥ 2 yrs)
- Growth Chart: See attached.

Estimated Requirements were calculated as 74 kcal/kg and 1.6 to 1.8 gms protein/kg. Energy requirement were based on the REE per the WHO calculation to prevent overestimation and overfeeding.

- Kcal: REE (WHO calculation)
  60.9 x wt (kg) -54= 786.42
  REE x Stress factor= (1.25-1.5) x REE
  786.42 x 1.3= 1021
  1021 ÷ 13.8 (kcal/kg)= 74 kcal/kg

Protein requirements were calculated based on Nutrient Recommendations for Pediatric Acute Renal Failure (1.5-1.8 gms/kg/day) and the Nutrient Recommendations for Pediatric Patients- Hemodialysis (1.6 gms/kg/day) due to increased needs secondary to losses in dialysis.
Fluid requirements were matched to Urinary Output (UOP) + insensible losses to prevent fluid overload since the patient was anuric.

Nutritionally significant medications: Cefotaxime, Clindamycin, Vancomycin
Nutritionally significant Intravenous fluids (D10 with Bicarb- on hold on 3/20)

Pertinent Labs at time of assessment:

Lab	**Normal Range**	**3/18/08**	**3/19/08**	**3/20/08**	**3/21/08**	**Indication for Abnormal Results**
Glu	70-110	88	66	74	52	NPO, IV fluids on hold
Na	132-141	132	132	137	140	Fluid overload
K+	3.3-4.7	2.7	4.3	3.0	2.9	Unclear
CL	97-107	102	98	99	98	
CO_2	16-25	16	18	20	22	
BUN	4-17	37	71	84	99	Kidney Failure
Cr	0.2-0.8	1.2	2.4	2.8	3.2	Kidney Failure
Ca	8.9-9.9	8.2	8.1	8.4	8.9	
HGB	10.1-12.5	7.2	7.5	6.4	7.5	Anemia, Fluid Overload
HCT	30.8-37.8	21.0	19.9	17.1	19.4	Anemia, Fluid Overload
T Bilirubin	< 0.8	23.1	27.8	49	----	RBC Hemolysis
Conjugated Bilirubin	0.1- 0.3	16.2	16.2	25.1	-----	RBC Hemolysis
ALT	19-59	79	79	324	-----	Liver Failure
Amylase	< 106	106	106	-----	217	Pancreatitis
Lipase	147-193	577	577	-----	1172	Pancreatitis
Albumin	3.7-5.5	1.7	----	----	------	↑albumin loss and ↓ albumin production

Assessment:
3/19/08: Chart reviewed. Patient sedated. Appears to have been well-nourished PTA. Compromised nutrition status for 3-4 days PTA associated with decreased oral intake and diarrhea. Anemia likely due to HUS. Elevated BUN, Creatinine due to ARF- to start IHD. Currently NPO- consider initiation of TPN on 3/20. Accuracy of length measurement questioned due to previous height of 85 cm at MD visit in November.

3/20/08: Chart reviewed. Patient with tachypnea, edema and slightly yellow sclera. More awake and alert today. IHD started 3/19 and second treatment given today. 600 ml fluid removed during treatment on 3/19. Removal goal is 1500 ml. I/O= 861/827 (700 ml from Dialysis). IV D10 with Bicarb IV currently on hold due to risk for overhydration secondary to anuria and IV fluids. Patient at moderate nutritional risk secondary to > 4 days with inadequate oral intake. Per PICU, initiation of nutrition support delayed due to concerns regarding risk of bowel necrosis/perforation from enteral feeding and liver injury from TPN.

3/21/08: Chart reviewed. + Liver failure, pancreatitis, ARF- on IHD. Spoke with parents to get diet history. Patient with good appetite/po intake of regular diet with two 8 oz. bottles of whole milk/day until onset of symptoms on 3/14/08 when po intake decreased. Patient remains NPO since 3/17/08. + central access. GI consult pending. Slight ↓ Wt. (13.18 kg.). I- 67 ml (IV) and O- 1028 ml (1L from IHD).Continues to be anuric.

Addendum: Per GI, ↑ LFTs consistent with sepsis and thrombotic microangiopathy. ↑ bile secondary to RBC hemolysis and would not be affected by TPN. TPN initiated on 3/22/08. Able to provide full calories and protein in TPN. On CRRT- Hemodialysis. 3/25/08- began transition from TPN to enteral feeds of Peptamen and Renalcal which both provide Medium-chain triglycerides (MCT).

Plan/Goals:
- Provide recommendations for nutrition support per GI consult.
- TPN started on 3/22/08. TPN order: D15%, P 1g/kg, IL 0.5/kg in 1050 ml of fluid. Provides 48 kcal/kg/day. Goal rate is ~ 75 kcal/kg/day.
- Recommendation for transition from TPN to transpyloric feeds via NJ tube: 500 ml 1/2 strength Peptamen Jr. (15 cal/oz.) + 250 ml Renalcal + 250 water= 1000 ml. Goal rate= 40 ml/hr x 24 hrs. Start at 5 ml/hr and advance as tolerated. Provides 15 kcal/oz, 76 kcal/kg, 1.8 gm protein/kg/day, 60-70% of the type of fat in the formula is MCT. Also provides 400 mg Phosphorus, 16.9 mEq K+ (1.3 mEq/kg), 500 mg Ca + 10 mEq Na (0.76 mEq/kg). Renalcal contains no electrolytes so the combination of Peptamen Jr. and Renalcal was chosen to meet electrolyte requirements. Transpyloric feeds via NJ tube were recommended due to poor gut perfusion and increased risk of aspiration.
- Monitor weight.
- Monitor tolerance to nutrition support.
- Monitor low Na and K+ levels- may need supplementation (Added to TPN on 3/24).
- Follow-up by Renal after discharge due to increased risk for future renal disease.