

Acute Diarrhea

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Resident Education Series

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Introduction

- Derived from Greek *dia* means “**through**” and *rhien* “**to flow**”

Definition

- Sudden onset of increased fluid content of the stool above normal
 - Duration:
 - Acute: < 2 weeks
 - Volume:
 - Infants and toddlers >10 mL/kg/day
 - Older children > 200 mL/day
- From Practical viewpoint:
 - Decrease in consistency (to loose or liquid) and increase in frequency of bowel movements to ≥ 3 per day

Epidemiology

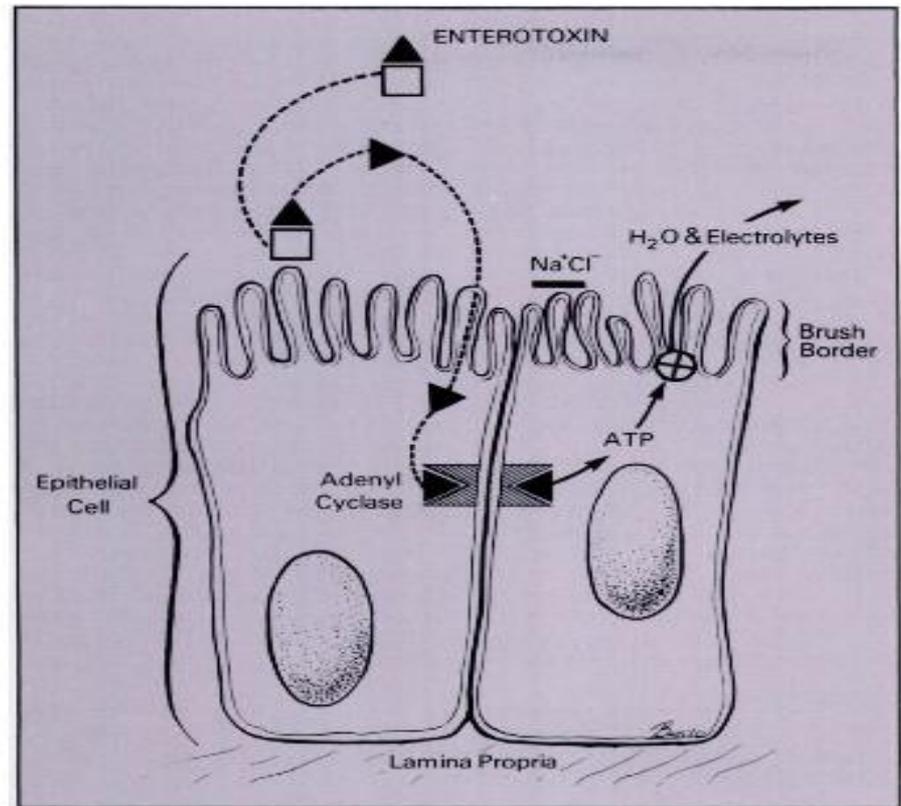
- WHO estimates: Diarrheal disease cause 17% of deaths in children < 5 yrs worldwide
- In United States:
 - Annually 38 million cases,
 - 2 million to 3.7 million physician visits,
 - 320,000 hospitalizations
 - associated with up to 9% of all hospitalizations in children < 5yrs
 - 325 to 425 deaths
- Seasonal peak in the winter

Pathophysiology

- Four processes that either individually or collectively contribute to diarrhea
 - Secretory
 - Cytotoxic
 - Osmotic
 - Inflammatory

Effect of bacterial enterotoxin on mucosal cells of the small intestine

- Enterotoxin stimulates secretion of fluid and electrolytes from mucosal crypt cells
 - Mediated through prostaglandins
 - Affects cAMP, GMP and calcium ion flows
 - Blocks absorption of fluid and electrolyte by the villi



Cytotoxic Process

- Destruction of small intestinal mucosal villi by infectious viral agent
 - Villi shorten after cell lysis
 - Decreased small bowel surface area decreases capability of small intestine to absorb fluid and electrolytes
 - Proportional increase in secretion with marked decrease in absorptive function of small bowel mucosa

Osmotic Process

- Commonly seen in malabsorption syndromes
 - Lactose intolerance
- Malabsorbed substance is osmotically active, leading to a net flux of water into the intestinal lumen – resulting in loose diarrheal stools
- Large intestinal flora is inundated with increased CHO, which then is metabolized and produces gas, abdominal pain and decreased stool pH

Inflammatory Process

- Inflammation of mucosa and submucosa of terminal ileum and large bowel
- Invasion by a bacterial agent causes edema along with mucosal bleeding and leukocytic infiltration
- Inflammation causes increased colon motility and frequent stooling with tenesmus
- Alteration in GI motility – often with secretory and cytotoxic processes
- Luminal dilation, delayed gastric emptying (cause nausea and vomiting), rapid intestinal transit time with marked peristaltic rushes

Cause of Acute Diarrhea: Infectious / Inflammatory

Secretory

- E. coli
- Vibrio cholerae
- Clostridium difficile
- Clostridium perfringes
- Aeromonas hydrophila
- Staphylococcus aureus
- Vibrio parahemolyticus
- Bacillus cereus
- Shigella
- Salmonella
- Yersinia enterocolitica
- Giardia lamblia

Cytotoxic

- Rotavirus
- Norwalk agent
- Cryptosporidium
- Escherichia coli

Dysenteric

- Campylobacter fetus
- Clostridium difficile
- Salmonella
- Shigella
- Yersinia enterocolitica
- Entamoeba histolytica

Causes of Acute Diarrhea

- Drug Induced
 - Antibiotic associated
 - Laxatives
 - Antacids that contain magnesium
 - Opiate withdrawal
- Surgical conditions
 - Acute appendicitis
 - Intussusception
- Heavy metals or toxins
 - Copper, tin, zinc
 - Chemotherapy or radiation induced enteritis
- Vitamin Deficiency
 - Niacin, Folate
- Vitamin Toxicity
 - Vitamin B3, C, Niacin
- Disorders of Malabsorption
 - Lactase deficiency
 - Sucrase-isomaltase deficiency
- Food allergies or intolerance
 - Cow's milk or soy protein allergy
 - Methylxanthines(caffeine , theobromine, theophylline)

Indications of Moderate to Severe Disease

- Age < 3 months
- Weight <8 kg
- History of premature birth, chronic medical conditions or concurrent illness
- Fever $\geq 38^{\circ}$ C for infants <3 mo or $\geq 39^{\circ}$ C for children 3 to 36 months
- Visible blood in the stool
- High output diarrhea
- Persistent emesis
- Signs of dehydration
- Mental status changes
- Inadequate response to or caregiver unable to administer ORT

Physical Examination of the Child With Diarrhea

- Growth chart
- Vital signs
- Muscle mass
- Subcutaneous fat
- Pubertal stage
- Psychomotor development
- Skin (perianal)
- ENT region- otitis media
- **Abdomen**
 - Organomegaly
 - Tenderness
- Rectal exam
- Stool sample
- Color Consistency
- ? Occult blood → Hemoccult
- ? pH → Indicator
- ? Fermentation → Clinitest

Signs of Dehydration

Symptom	Minimal or No Dehydration ($< 3\%$ Loss of Body Weight)	Mild to Moderate Dehydration ($3\text{--}9\%$ Loss of Body Weight)	Severe Dehydration ($> 9\%$ Loss of Body Weight)
Mental status	Well; alert	Normal, fatigued or restless, irritable	Apathetic, lethargic, unconscious
Thirst	Drinks normally; might refuse liquids	Thirsty; eager to drink	Drinks poorly; unable to drink
Heart rate	Normal	Normal to increased	Tachycardia, with bradycardia in most severe cases
Quality of pulses	Normal	Normal to decreased	Weak, thready, or impalpable
Eyes	Normal	Slightly sunken	Deeply sunken
Tears	Present	Decreased	Absent
Mouth and tongue	Moist	Dry	Parched
Breathing	Normal	Normal; fast	Deep
Skin fold	Instant recoil	Recoil in < 2 s	Recoil in > 2 s
Capillary refill	Normal	Prolonged	Prolonged; minimal
Extremities	Warm	Cool	Cold; mottled; cyanotic
Urine output	Normal to decreased	Decreased	Minimal

Adapted from Ref (5): Duggan C, Santosham M, Glass RI. The management of acute diarrhea in children: oral rehydration, maintenance, and nutritional therapy. *MMWR Recomm Rep* 1992;41(No. RR-16):1–20.

Treatment of Dehydration

TABLE 2: Summary of treatment based on degree of dehydration

Degree of dehydration	Rehydration therapy	Replacement of losses
Minimal or no dehydration	Not applicable	<10 kg body weight: 60–120 mL oral rehydration solution (ORS) for each diarrheal stool or vomiting episode >10 kg body weight: 120–240 mL ORS for each diarrheal stool or vomiting episode
Mild to moderate dehydration	ORS, 50–100 mL/kg body weight over 3–4 hours	Same
Severe dehydration	Lactated Ringer's solution or normal saline in 20 mL/kg body weight intravenous amounts until perfusion and mental status improve; then administer 100 mL/kg body weight ORS over 4 hours or 5% dextrose ½ normal saline intravenously at twice maintenance fluid rates	Same; if unable to drink, administer through nasogastric tube or administer 5% dextrose ¼ normal saline with 20 mEq/L potassium chloride intravenously

Composition of Oral Rehydration Solution

Ingredients	ESPGHAN-ORS(mmol/L)	WHO –ORS 2002(mmol/L)
Glucose	74-111	75
Na	60	75
K	20	20
Base	10(citrate)	30
Cl	60	65
Osmolality	225-260	245

Early Refeeding

- Early refeeding is recommended in managing acute gastroenteritis
 - Luminal contents are known growth factors for enterocytes and help facilitate mucosal repair after injury
 - Almost all infants with acute gastroenteritis can tolerate breastfeeding
 - Diluted formula does not provide any benefit over full-strength formula
- Infants with the most severe diarrhea may require lactose-free formula until mucosal recovery is complete at around 2 weeks
- Older children can consume a regular age-appropriate diet
 - BRAT diet not recommended

Other Treatment Options

- Antibiotics
- Zinc
- Immunoglobulin
- Drugs
- Probiotics

Antibiotics

- May prolong illness, increase carrier state & increased morbidity
- **Antibiotic use always indicated**
 - *V. cholera*, *Shigella* and *Giardia lamblia*
- **Antimicrobial therapy in selected circumstances**
 - Enteropathogenic E. Coli when running a prolonged course
 - Enteroinvasive E. Coli based on serologic, genetic and pathogenic similarities with shigella
 - Yersinia infection in subjects with sickle cell disease
 - Salmonella infection in very young infants, if febrile or with positive blood culture

Zinc

- Micronutrient deficiency in malnourished children with diarrhea
- Zinc supplementation in acute diarrhea (WHO/UNICEF in 2004)
 - Infants > 6 months of age – 10mg/day
 - Children with 20mg/day
 - Duration 10- 14 days
- Any of zinc salts ie, sulphate, gluconate or acetate may be used
- Benefits – can shorten course and severity

Immunoglobulin

- Oral or enteral immunoglobulin in treatment of rotavirus diarrhea (immunocompromised or immunocompetent)
- Current evidence does not support the use of oral immunoglobulin preparations to prevent rotavirus infection in low birth weight infants

Probiotics

- Modify the composition of the colonic microflora and act against enteric pathogens, their mechanism of action is yet to be defined
 - May be effective for acute diarrhea, in addition to ORS
 - Proof of efficacy is limited to few strains, *Lactobacillus rhamnosus* GG (LGG) and the yeast *Saccharomyces boulardii*
- For acute diarrhea in developed countries shorten duration of diarrhea by 1 day
 - Effects seen when administered early in course and dose of 1 billion CFU/d
- Efficacy is evident in viral diarrheas of mild to moderate degree, less or absent in invasive bacterial diarrhea

Prevention

- Education
- Sanitation
- Hygiene
 - Simple hand washing has decreased incidence by >50%
- Breast feeding
- Food safety
 - Food safety has also been effective in decreasing the incidence by >50%
- Appropriate use of oral rehydration therapy
- Probiotics
- Development of vaccinations
 - Rota virus vaccine – RotaTeq and Rotarix