

Lecture 3: Acute Diarrhea

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Learning objectives: By the end of this lecture the students should know::

- What is acute diarrhea?
- Why the children may get acute diarrhea? ``Causes``
- Clinical scenario of common infectious causes of acute diarrhea
- What are the Complications may associated with diarrhea?.
- How can we Prevent acute diarrhea?.

Def. : Diarrhea is best defined as excessive loss of fluid and electrolytes in the stool(frequent loss of loose stool). **Or defined as** an increase in stool frequency to twice the usual number per day in infants or three or more loose or watery stools per day in older children.

Diarrheal diseases are one of the leading causes of morbidity and mortality in children worldwide (the 4th most common cause of child mortality worldwide.)

Causes of acute diarrhea:-

1. Gastroenteritis.
2. Systemic infection.
3. Antibiotic associated.
4. Others: food poisoning

Mechanism of diarrhea

1. **Secretary**: diarrhea results from defective absorption or increase secretion of fluid and electrolytes, producing watery diarrhea of normal stool osmolality. e.g cholera,
2. **Osmotic**: result from maldigestion or ingestion of unabsorbable solute produce watery diarrhea of high stool osmolality (lactase deficiency, glucose-galactose malabsorption)
3. **Increase motility**: result from decrease transit time. e.g. irritable bowel syndrome
4. **Decrease motility**: stasis lead to bacterial over growth (pseudoobstruction, blind loop)
5. **Reduce surface area**: decrease functional absorptive capacity. e.g. short bowel syndrome, celiac disease, and rota virus enteritis.
6. **Mucosal invasion**: inflammation and ulceration of mucosa. e.g. amoebiasis

Gastroenteritis:

The term *gastroenteritis* denotes infections of the gastrointestinal tract caused by bacterial, viral, or parasitic pathogens.

Many of these infections are food-borne illnesses. The most common manifestations are diarrhea and vomiting, which may also be associated with systemic features such as abdominal pain and fever.

Enteric pathogen varies by geographical location, children in developing countries become infected with diverse group of bacterial and parasitic pathogens.

Where as both developed and developing countries children acquire rota virus (and other viruses), and Giardia during their first 5 years of life.

Risk factors for gastroenteritis

1. Major risks include environmental contamination. (Inadequate hygiene, poor sanitation, and lack of clean drinking water)
2. lack of exclusive or predominant breast-feeding.
3. Malnutrition increases several fold the risk of diarrhea and associated mortality The risks are higher with vitamin A deficiency, and Zinc deficiency
4. Ingestion of raw or undercooked food, improper food handling.
5. Additional risks include young age, immune deficiency and measles,

Others: like blood group O, vitamin A deficiency in *Vibrio cholerae* O1 and O139

Clinical Signs Associated With Dehydration

SYMPTOM	MINIMAL OR NO DEHYDRATION	SOME DEHYDRATION	SEVERE DEHYDRATION
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
Breathing	Normal	Normal; fast	Deep
Eyes	Normal	Slightly sunken	Deeply sunken
Tears	Present	Decreased	Absent
Mouth and tongue	Moist	Dry	Parched
Skinfold	Instant recoil	Recoil in <2 sec	Recoil in >2 sec
Capillary refill	Normal	Prolonged	Prolonged; minimal
Extremities	Warm	Cool	Cold; mottled; cyanotic
Urine output	Normal to decreased	Decreased	Minimal

Modified from Duggan C, Santosham M, Glass RI: The management of acute diarrhea in children:

Viral-gastroenteritis:

Rotavirus:-is the most frequent cause of diarrhea during winter months.

Rout: Fecally contaminated foods. Ready-to-eat foods touched by infected food workers (salads, fruits) and outbreaks are common in children's hospitals and childcare centers. The virus is shed in stool at a very high concentration before and for days after the clinical illness

Aerosol transmission of rotavirus may be possible

Nearly all infants and children worldwide were infected by 2 yr of age before vaccine introduction.

Primary infection with rotavirus causes moderate to severe diseases, while reinfection in adolescent usually produce mild illness. The virus invades the epithelium of the upper S.I., and in sever cases may extend throughout the S.I. and colon causing villous damage and sometime secondary transient dissaccharidase deficiency. Rotavirus infection typically begins after an incubation period of < 48 hr (range: 1-7 days) with mild to moderate fever as well as vomiting, the pt have vomiting which may last for 3-4 days with diarrhea which usually persist for 7-10 days. Dehydration may develop and progress rapidly, particularly in infants. severe disease mostly occurs among children 4-36 mo of age

Lab finding:

- **Isotonic dehydration with acidosis** is the most common finding in children with severe viral enteritis.
- **General stool examination, GSE: The stools are free of RBCs and leukocytes.**
- Although the white blood cell count may be moderately elevated secondary to stress, the marked left shift seen with invasive bacterial enteritis is absent
- **The diagnosis** is confirmed by **PCR stool testing**, which offer >90% specificity and sensitivity, are available for detection of group A rotavirus, caliciviruses, and enteric adenovirus in stool samples.

Treatment:

- 1- Avoiding and treating dehydration are the main goals in treatment of viral enteritis. Rehydration via the oral route can be achieved in most patients with mild to moderate dehydration. Severe dehydration requires immediate intravenous therapy followed by oral rehydration. **Breastfeeding should be continued even during rehydration**
- 2- Antiemetics such as **ondansetron** may help alleviate vomiting in children older than 2 yr
- 3- **oral zinc** in some form for 10–14 days during and after diarrhea (10 mg/day for infants <6 mo of age and 20 mg/day for those >6 mo)
- 4- Therapy with probiotic organisms such as Lactobacillus species has been shown to be helpful only in mild cases and not in dehydrating disease

Bacterial gastro-enteritis:

Many bacterial entero-pathogens may produce diarrhea, the infection usually acquired by feco-oral route.

Bacterial Diarrhea. Although there is considerable overlap, fever >40°C, overt fecal blood, abdominal pain, no vomiting before diarrhea onset, and high stool frequency (>10 per day) are more

***E. coli:-** may produce diarrhea by different mechanism:-

Both *Entero-pathogenic E.coli* and *Entero-toxogenic E.coli* produce toxin which increase secretion and reduce absorption.

Entero-invasive E.coli cause mucosal damage.

Entero-haemorrhagic E.coli cause haemorrhagic colitis +/-Hemolytic uremic syndrome.

***Salmonella:-** It transmitted by ingestion of contaminated food or by contact with infected animals .it produce diarrhea by invading the intestinal mucosa causing nausea, vomiting , crampy abdominal pain followed by loose watery stool and fever.

Diagnosis: GSE: The stool typically contains a moderate number of pus cell and occult blood.

- stool culture.
- Blood culture in young infants.

Treatment: -Rehydration and Oral zinc

Antibiotics: No antibiotics for uncomplicated gastroenteritis in normal hosts caused by non-typhoidal species. **Treatment indicated** in infants <3 mo, and patients with malignancy, chronic GI disease, severe colitis hemoglobinopathies, or HIV infection, and other immunoincompetent patients.

Cefotaxime 100-200 mg/kg/day every 6-8 hr for 5-14 days

Or **Ceftriaxone** 75 mg/kg/day once daily for 7 days

Or **Ampicillin** 100 mg/kg/day every 6-8 hr for 7 days

Or **Cefixime** 15 mg/kg/day for 7-10 days

***Shigella:** Usually affect children < 2 years age .

it transmitted by direct person to person feco-oral contact ,it penetrate the epithelium produce inflammation, ulceration and bleeding .it can also produce toxins resulting in watery diarrhea, crampy abdominal pain and high grade fever >40 c.

Shigellosis may associated with seizure .

Diagnosis :GSE and Stool culture .

Treatment: 1- Rehydration.

2-A single large dose of vitamin A (200,000 IU) lessens severity of shigellosis in settings where vitamin A deficiency is common.

3- Oral zinc

4- **Antibiotics:** Currently, in most developed and developing countries, Shigella strains are often resistant to ampicillin and TMP-SMX; therefore, these drugs should not be used for empirical treatment.

Ceftriaxone (50 mg/kg as a single daily dose IV or IM) can be used for empirical therapy, **Oral cefixime** (8 mg/kg/24 hr divided every 12-24 hr).

Azithromycin (12 mg/kg orally for the 1st day, followed by 6 mg/kg/day for the next 4 days).

Ciprofloxacin (20-30 mg/kg/24 hr divided into 2 doses) used to be a back-up drug to treat shigellosis but is now the drug of choice recommended by the WHO for all patients with bloody diarrhea, irrespective of their ages.

A child who has typical dysentery and who responds to initial empirical antibiotic treatment should be continued on that drug for a full 5-day course even if the stool culture is negative.

***Campylobacter jejuni:** the infection is spread by person to person contact and by contaminated food and water: Raw and undercooked poultry, unpasteurized milk, contaminated water .it invade the

mucosa causing enterocolitis most pt have mild disease recover spontaneously before reaching the diagnosis.

Treatment : Rehydration , Oral zinc

Antibiotics are recommended for patients with severe course, and for children who are immunosuppressed or have underlying diseases. Most Campylobacter isolates are susceptible to macrolides, fluoroquinolones, aminoglycosides, chloramphenicol, tetracyclines, and clindamycin

***Yersinia enterocolitica** :- Usually transmitted by pets and foods causing self-limiting disease (3days-3weeks). Appendicitis-like symptoms (diarrhea and vomiting, fever, and abdominal pain) occur primarily in older children and young adults.

Treatment Enterocolitis in an immunocompetent patient is a self-limiting disease, and no benefit from antibiotic therapy is established. For patients with systemic illness and very young children with either of :- TMP-SMX aminoglycosides, third-generation cephalosporins, and quinolones.

***Vibriosis**: Cholera is acute watery diarrhea caused by group of toxins produced by *V.cholerae* ,the bacteria is transmitted by feco-oral route ,the affected pt gets watery diarrhea & vomiting with low grade fever. in sever cases the pt have profuse painless watery rice-water diarrhea with fishy-odor & rapidly develop sever dehydration +/-shock & renal failure if untreated

Diagnosis: GSE and Stool Culture: the transport media: Sea salt

Culture media: TCBS, Or TTGA

ELISA testing for toxins.

Treatment: 1-**REHYDRATION** Vomiting is not a contraindication to ORS. Severely dehydrated patients require intravenous fluid, ideally with lactated Ringer solution.

2- Oral Zinc should be given as soon as vomiting stops. usually within 4-6 hr after initiation of rehydration therapy)

3- Antibiotics: Antibiotics should only be given in cases with moderately severe to severe dehydration, Antibiotics shorten the duration of illness, decrease fecal excretion of vibrios, decrease the volume of diarrhea, and reduce the fluid requirement during rehydration.

Single-dose antibiotics increase compliance with either of: Doxycycline 300 mg PO given as a single dose OR **Ciprofloxacin** 1g PO single dose Or **Azithromycin** 1g PO single dose(for adult)

Children: Erythromycin 12.5 mg/kg/dose 4 times a day ×3 days (up to 500 mg per dose ×3 days)or **Azithromycin**, 20 mg/kg as a single dose (up to 1 g)

Or **Ciprofloxacin** 20 mg/kg PO as a single dose

Or **Doxycycline** 2-4 mg/kg PO as a single dose

- **Parasitic gastroenteritis:**

1. Entameba histolytica
2. Giardia lamblia
3. Cryptosporidium spp.
4. Blastocystis hominis

Amebiasis: protozoal infection caused by **Entameba histolytica** ,it transmit by any uncooked food or food contaminated by an ill food handler after cooking; drinking water, or by person to person contact ,it can cause invasive disease with flask shape ulcer in the intestinal mucosa. The infected individual is mostly asymptomatic. 2- 8 % of pt develop diarrhea with blood and mucus, fever, ,abdominal pain ,headache and chills, untreated pt may have perforation and subsequent peritonitis

Ameba may disseminated to involve extra-intestinal organs ,the liver is the most common organs affected (amebic liver abscess).

Diagnosis : 1. stool antigen testing or PCR, has a greater than 95% sensitivity and specificity.

2.GSE: has a sensitivity of 60%. which can be increased to 85–95% by examining three stool.

Treatment :1- rehydration . 2- Oral zinc.

3- Nitroimidazole such as **Metronidazol** for amebic Colitis or liver abscess: 35-50 mg/kg/day in 3 divided doses for 7-10 days or **Tinidazol tab.** for amebic Colitis 50 mg/kg/day once daily for 3 day Then followed by a **luminal amebicide, Diloxanide furoate** 20 mg/kg/day in 3 divided doses for 7 days.

Giardiasis: infection with *G lamblia* is world wide distribution affects humans, dogs, and other wild animals. Route :feco-oral route. outbreak may occurs in day care center. the pt may be asymptomatic , or may have sudden explosive watery foul-smelling stool, flatulence ,abdominal distension, nausea, and vomiting.some time the pt present with chronic diarrhea .

- **Diagnosis OF Giardiasis:** 1. GSE (3 samples) 2. Examination of duodenal aspirate.
3. Stool enzyme immunoassay (EIA) or direct fluorescent antibody tests for Giardia antigen.

Treatment : Rehydration., Oral zinc.

Tinidazole tab >3 yr: 50 mg/kg once,
or **Metronidazol**(15 mg/kg/day tds for 5-7 days)

Complications of acute diarrhea:

Most of the complications associated with gastroenteritis are related to delays in diagnosis and delays in the institution of appropriate therapy

1. dehydration, pre-renal renal failure, shock, acidosis
2. Electrolytes disturbance: Hypokalemia may cause ileus., Hypo/hyponatremia, and Hypocalcemia may cause convulsions.
3. Disseminated infections.
4. Hypoglycemia.
5. Secondary disaccharidase deficiency... chronic diarrhea... Malabsorption and malnutrition.
6. Convulsion:
7. **Extraintestinal Manifestations of Enteric Infections:**
 - a) Reactive arthritis: (*Salmonella, Shigella, Yersinia, Campylobacter*)
 - b) Guillain-Barré syndrome: (*Campylobacter*)
 - c) Glomerulonephritis: (*Shigella, Campylobacter, Yersinia*)
 - d) Erythema nodosum: (*Yersinia, Campylobacter, Salmonella*)
 - e) Hemolytic uremia syndrome: (*Shigella dysenteriae* 1, *Escherichia coli* 0157: H7)
 - f) Hemolytic anemia:(*Campylobacter, Yersinia*).

Prevention of diarrhea:

1.Promotion of Exclusive Breast-Feeding: Exclusive breast-feeding protects very young infants from diarrheal disease through the promotion of passive immunity and through reduction in the intake of potentially contaminated food and water.

2. Improved Complementary Feeding Practices Complementary foods should be introduced at 6 mo of age while breast-feeding should continue for up to 1 yr (longer period for developing countries).

Vitamin A supplementation reduces childhood mortality by 34%; improved vitamin A status reduces the frequency of severe diarrhea

3.**Vaccination :-**Rotavirus , vaccines against *Shigella* and ETEC., cholera vaccine

4. **Improved water and sanitary facilities and promotion of personal hygiene.**

5. **Improved management of diarrhea** The ORS and zinc supplementation for the management of diarrhea, coupled with selective and appropriate use of antibiotics, have the potential to reduce the number of diarrheal deaths among children.

References:

- Nelson Textbook of Pediatrics , 21 edition .
- Nelson essentials Textbook of Pediatrics , 7th edition.
- Illustrated textbook of pediatrics.5th edition