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Complication of Gastroenteritis in Pediatrics

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Done By

Ayat Muhammad Ghani

Supervised by

Prof. Dr. Shukur Mahmood Yaseen

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بسم الله الرحمن الرحيم

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صدق الله العظيم

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Abstract

Gastroenteritis is a common infection of the gastrointestinal tract characterized by diarrhea with or without vomiting and cramping abdominal pain. Acute gastroenteritis is defined as a diarrheal disease of rapid onset, with or without nausea, vomiting, fever, or abdominal pain. In the United States, acute gastroenteritis accounts for 1.5 million office visits, 200,000 hospitalizations, and 300 deaths in children each year. Evaluation of a child with acute gastroenteritis should include a recent history of fluid intake and output. Most cases of gastroenteritis do not need hospital admission and can be managed using oral hydration. Enteral rehydration is preferable to intravenous (IV) hydration. Similar symptoms may occur in other illnesses which should be considered before the diagnosis of gastroenteritis is made. Dehydration and electrolyte abnormalities are the commonest complications requiring treatment. Electrolyte abnormalities such as hypernatremia (Na >145mmol/L) and hypokalemia are potentially dangerous and, if present, close monitoring is critical. Severe dehydration can cause life-threatening shock and should be managed with 20ml/kg boluses of IV 0.9% sodium chloride. Prior to discharge ensure that the family can access timely medical review should the child deteriorate. In this study, our aim was to understand the various etiologies that cause gastroenteritis in Children, and also discuss methods of management.

List of Content

Introduction

Acute gastroenteritis is defined as diarrheal disease of rapid onset, with or without nausea, vomiting, fever, or abdominal pain [1]. It involves increased stool frequency or altered stool consistency that is unrelated to chronic conditions [2]. Worldwide, 68% of diarrheal disease occurs in young children [3]. Diarrheal disease is the fifth leading cause of death in children worldwide, accounting for about 2.5 million deaths [4-6]. In the United States, acute gastroenteritis is not a major cause of death but leads to significant morbidity, especially in children younger than five years, accounting for 1.5 million office visits, 200,000 hospitalizations, and 300 deaths in children each year [1, 7]. Acute gastroenteritis is a common and costly clinical problem in children. It is a largely self-limited disease with many etiologies. The evaluation of the child with acute gastroenteritis requires a careful history and a complete physical examination to uncover other illnesses with similar presentations. Minimal laboratory testing is generally required. Treatment is primarily supportive and is directed at preventing or treating dehydration. When possible, an age-appropriate diet and fluids should be continued. Oral rehydration therapy using a commercial pediatric oral rehydration solution is the preferred approach to mild or moderate dehydration. The traditional approach using "clear liquids" is inadequate. Severe dehydration requires the prompt restoration of intravascular volume through the intravenous administration of fluids followed by oral rehydration therapy. When rehydration is achieved, an age-appropriate diet should be promptly resumed. Antiemetic and antidiarrheal medications are generally not indicated and may contribute to complications. The use of antibiotics remains controversial. This review focuses on acute gastroenteritis in children, where viruses account for 75% to 90% of childhood acute infectious gastroenteritis. Approximately 20% of cases are due to bacteria. Diarrhea persisting

for at least 14 days is more commonly caused by parasitic infections, which account for less than 5% of acute gastroenteritis cases. The specific causative microorganisms vary with season and climate [8].

Pediatric acute gastroenteritis remains an important clinical illness commonly encountered by family physicians. Its attendant problems of vomiting, diarrhea and dehydration continue to present significant risks to children and are responsible for considerable health care expenditures.

Estimates of the overall incidence of acute gastroenteritis range from 1.3 to 2.3 episodes of diarrhea per year in children under five years of age. Each year, more than 300 U.S. children die from this illness .In the United States alone, gastroenteritis accounts for more than 220,000 hospital admissions per year in children less than five years of age, or approximately 10 percent of hospitalizations in this age group [9]. Direct costs for hospital and outpatient care are estimated to exceed $2 billion per year [10].

Over the past two decades, pediatric acute gastroenteritis has been the subject of considerable worldwide attention and effort. Particular emphasis has been given to the development and promotion of inexpensive, easy-to-use oral rehydration solutions for the treatment of dehydration, the problem that is most responsible for morbidity and mortality in children with this illness. Despite the growing body of evidence supporting the safety and efficacy of oral rehydration solutions, they remain underutilized, and the management of gastroenteritis continues to vary considerably in the developed world. Study results suggest that some physicians do not know the current standards for oral rehydration therapy. Even physicians who are familiar with these standards do not necessarily use oral rehydration therapy in their dehydrated pediatric patients [11, 12]. Common management errors include using oral rehydration solutions in children with little or no dehydration, administering intravenous rehydration therapy to children with only moderate dehydration and

inappropriately withholding oral rehydration solutions or other feeding in children with vomiting [13].

In an attempt to improve physicians' understanding of the management of acute gastroenteritis in children and to bring more uniformity to treatment approaches and costs in the United States, the American Academy of Pediatrics (AAP) formulated and published a practice parameter on the subject in 1996. The AAP's recommendations, adopted after extensive review and evaluation of the relevant literature, address three specific issues: methods of rehydration, refeeding during and after rehydration and the use of antidiarrheal agents for symptom control [10].

Aims of the Study:

The present study aims to determine the complication of gastroenteritis in pediatrics.

Review Article

Definition and Causes:

A uniform definition of acute gastroenteritis does not exist. The AAP defines acute gastroenteritis as "diarrheal disease of rapid onset, with or without accompanying symptoms or signs such as nausea, vomiting, fever or abdominal pain [10]. The hallmark of the disease is increased stool frequency with alteration of stool consistency.

Worldwide, infectious agents (viruses, bacteria and parasites) are by far the most common causes of acute gastroenteritis **(Table 1)** [13, 14]. Viruses, primarily rotavirus species, are responsible for 70 to 80 percent of infectious diarrhea cases in the developed world, various bacterial pathogens account for another 10 to 20 percent of cases and parasitic organisms such as Giardia species cause fewer than 10 percent of cases [15]. This distribution is affected by climate and season, as evidenced by the dramatic increase in rotavirus cases in the United States during the winter months. These winter rotavirus infections account for more than 50 percent of hospitalizations for pediatric gastroenteritis. Other factors that increase the risk of acute gastroenteritis in children include attendance at day care centers and impoverished living conditions with poor sanitation [16].

Table 1 : Etiologic Agents for Pediatric Infectious Gastroenteritis in the United States

PATHOGENS	INFLAMMATORY AGENTS	NON INFLAMMATORY AGENTS
Viruses		*Rotavirus* (most common) *Enteric adenovirus* *Norwalk virus* *Calicivirus* *Astrovirus* *Parvovirus*
Bacteria	*Salmonella* (most common) *Shigella* (second most common(*Campylobacter jejuni* *Yersinia enterocolitica* (more common in Europe and Canada(*Hemorrhagic E. coli* O157:H7 *Clostridium difficile* (iatrogenic)	*Toxigenic Escherichia coli*
Parasites		*Giardia lamblia* (most common) *Cryptosporidium*

Evaluation

CLINICAL ASSESSMENT:

The evaluation of the child with symptoms of acute gastroenteritis begins with a careful history to elicit information that might point to other illnesses with similar presentations. Respiratory symptoms such as cough, dyspnea or tachypnea may indicate the presence of an underlying pneumonia. Urinary frequency, urgency or pain may be symptoms of pyelonephritis, an earache may be a symptom of acute otitis media, and high fever and altered mental status may be signs of meningitis or sepsis. Factors such as travel to underdeveloped countries, exposure to untreated drinking or washing water sources, contact with animals or birds, day care center attendance, recent antibiotic treatment or even a recent change in diet may suggest other specifically treatable causes of vomiting and diarrhea.

A second goal of the history is to assess the severity of the symptoms and the risk of complications such as dehydration. The presence or absence of fever, the amount and type of oral intake, and the frequency and estimated volume of emesis or stool are important factors to consider. Fever increases insensible water loss. Emesis, stool and urine volume in excess of intake invariably leads to significant dehydration. Stool characteristics such as the presence of blood should prompt consideration of inflammatory bacterial disease and a much more aggressive work-up and intervention [17].

The physical examination has two main functions: a search for signs of comorbid conditions and an estimate of the level of dehydration. The first objective can be accomplished with a careful general examination. The second objective is more difficult to achieve. The primary tasks are to assess the adequacy of perfusion and to determine whether dehydration is severe enough to cause hemodynamic instability. It may be most helpful to compare the patient's present weight with the last recorded weight in the chart, to assess the patient's orthostatic vital signs and to carefully review the patient's recent oral fluid intake.

Clinical signs may also be used to classify the patient's dehydration as mild, moderate or severe [11]. Evidence exists, however, that traditional clinical signs are not always reliable in determining the degree of dehydration. For example, capillary refill time can be affected by ambient temperature [18]. One study found that only decreased peripheral perfusion, deep breathing and decreased skin turgor correlated with mild to moderate dehydration. Another study reported that prolonged skinfold time correlated best with the degree of dehydration, followed by altered mental status, sunken eyes and dry oral mucosa [19]. Yet another study found that as many as 87 percent of children admitted to the hospital for dehydration on the basis of clinical signs had mild or no dehydration based on a comparison of their weights on admission and discharge (when they were judged to be fully rehydrated); 82 percent of these patients received intravenous rehydration therapy [20].

LABORATORY ASSESSMENT

In the past, a number of laboratory studies were used to evaluate children with acute vomiting and/or diarrhea. Because oral rehydration therapy has become the preferred method of treating dehydration, routine laboratory testing is no longer necessary, although it may be helpful in individual patients or when oral replacement therapy fails.

High urinary specific gravity may indicate significant dehydration when combined with a history of decreased urine output. Serum chemistry measurements such as electrolyte, blood urea nitrogen and creatinine levels do not change the initial management approach in most patients [21].Hemodynamically stable children can be safely treated with oral rehydration therapy with only minimal risk of developing significant electrolyte abnormalities [22].

Laboratory studies should be performed in children who are severely dehydrated and children who are receiving intravenous rehydration therapy. Serum electrolyte levels should also be obtained in children who show signs of hypernatremia or hypokalemia **(Table 2)**, although evidence exists that these conditions, as well as

hyponatremia, may resolve without complications when oral rehydration therapy is used [23].

Table 2: Signs of Hypernatremia and Hypokalemia in Dehydration

Hypernatremia	Hypokalemia
Cutaneous signs Warm, "doughy" texture Possibly decreased skinfold tenting in severe dehydration, thereby giving appearance of lower level of dehydration Neurologic signs Hypertonia Hyperreflexia Lethargy common, but marked irritability when touched	Weakness Ileus with abdominal distention Cardiac arrhythmias

Studies aimed at pinpointing causative agents are usually only marginally helpful in children with domestically acquired gastroenteritis. Yet the presence of gross or occult blood in the stool should raise suspicion of such pathogens as Shigella species, Campylobacter species and hemorrhagic *Escherichia coli* strains. Large numbers of leukocytes on a fecal smear may also indicate an inflammatory bacterial process. In the absence of gross blood or leukocytes, costly stool cultures usually have a very low yield and rarely change clinical management because most noninflammatory diarrheas are self-limited [24].

Similarly, viral studies, such as rotavirus antigen tests, may confirm the causative agent but do not usually change management. Giardia antigen studies and smears for ova and parasites are generally not indicated unless the diarrheal illness lasts more than 10 days or a likely exposure history exists [25].

Assessment of Dehydration

Dehydration related to acute gastroenteritis is a major concern in pediatric patients. Therefore, clinicians in primary care offices, emergency departments, and hospital settings must assess the circulatory volume status as part of the initial evaluation of children presenting with acute gastroenteritis. This assessment is essential in guiding the decision making regarding therapy and patient disposition. In 1996, the CDC published recommendations on the assessment of dehydration, which were subsequently endorsed by the American Academy of Pediatrics (AAP). These guidelines classified patients into three groups based on their estimated fluid deficit: mild dehydration (3%–5% fluid deficit), moderate dehydration (6%–9% fluid deficit), and severe dehydration (>10% fluid deficit or shock). These classifications are similar to those delineated by the World Health Organization (WHO) in 1995, which also divided patients into three groups: no signs of dehydration (10%). The authors of studies have evaluated the correlation of clinical signs of dehydration with posttreatment weight gain and have demonstrated that the first signs of dehydration might not be evident until 3% to 4% dehydration. Furthermore, more obvious clinical signs of dehydration become apparent at 5% dehydration, and indications of severe dehydration become evident when the fluid loss reaches 9% to 10%. As a result, the CDC revised its recommendations in 2003 and combined the mild and moderate dehydration categories, acknowledging that the signs of dehydration might be apparent over a relatively wide range of fluid loss **(Table 3)**. The ultimate goal of this assessment is to identify which patients can be sent home safely, which should remain under observation, and which are candidates for immediate, aggressive therapy [26].

Minimal or No Dehydration:

The ultimate goal for patients who have minimal or no dehydration is to provide adequate fluid intake while continuing an age-appropriate diet. Nutrition should not be restricted. Patients who have diarrhea must have increased fluid intake to compensate for losses and cover maintenance needs; the use of ORSs containing at least 45 mEq Na þ/L is preferable to other fluids for preventing and treating dehydration. In principle, 1 mL of fluid should be administered for each gram of stool output. In the hospital setting, soiled diapers can be weighed (without urine), and the estimated dry weight of the diaper can be subtracted. At home, 10 mL of fluid can be administered per kilogram body weight for each watery stool or 2 mL per kilogram for each episode of emesis. As an alternative, children weighing less than 10 kg should be administered 60 to 120 mL (2–4 ounces) of ORS for each episode of vomiting or diarrheal stool, and those weighing more than 10 kg should be fed 120 to 240 mL (4–8 ounces). [27]

Mild to Moderate Dehydration

Children who have mild to moderate dehydration should have their estimated fluid deficit replaced rapidly. Fifty to 100 mL of ORS per kilogram body weight should be administered over a period of 2 to 4 hours to replace the fluid deficit, with additional ORS administered to replace ongoing losses. By using a teaspoon, syringe, or medicine dropper, small volumes of fluid should be offered initially and increased gradually as tolerated. If a child appears to want more than the estimated amount of ORS, more can be offered. Nasogastric (NG) feeding allows continuous administration of ORS at a slow, steady rate for patients who have persistent vomiting or oral ulcerations. Clinical trials support using NG feedings as a well-tolerated, more cost-effective method associated with fewer complications when compared with IV hydration. This method is particularly useful in the emergency department, where hospital admissions can be avoided if oral rehydration efforts are successful. In addition, a meta-analysis of randomized controlled trials comparing ORS versus IV rehydration in dehydrated children demonstrated shorter hospital

stays and improved parental satisfaction with oral rehydration. Hydration status should be evaluated on a regular basis in the clinical setting to objectively assess the response to therapy and to evaluate the correction of the dehydration. Upon return to the home setting, caregivers must be provided with and must understand fully the instructions containing specific indications prompting their return for re-evaluation and further medical care [26, 27].

Severe Dehydration:

Severe dehydration is characterized by a state of hypovolemic shock requiring rapid treatment. Initial management includes placement of an IV or intraosseous line and rapid administration of 20 mL/kg of an isotonic crystalloid (eg, lactated Ringer solution, 0.9% sodium chloride). Hypotonic solutions should not be used for acute parenteral rehydration. The patient should be observed closely and monitored on a regular and frequent basis. Serum electrolytes, bicarbonate, urea nitrogen, creatinine, and glucose levels should be obtained, although commencing rehydration therapy without these results is safe. A poor response to the initial, immediate treatment should raise the suspicion of an alternative diagnosis, including septic shock as well as neurologic or metabolic disorders. Therapy may be switched to an oral or NG route as soon as hemodynamic stability is accomplished and the patient's level of consciousness is restored [26, 27].

Table 3: Symptoms Associated With Dehydration [27]

Symptom	Minimal or No Dehydration (<3% Loss of Body Weight)	Mild to Moderate Dehydration (3%–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, impalpable
Breathing	Normal	Normal; fast	Deep
Eyes	Normal	Slightly sunken	Deeply sunken
Tears	Present	Decreased	Absent
Mouth and tongue	Moist	Dry	Parched
Skin fold	Instant recoil	Recoil in < 2 seconds	Recoil in < 2 seconds
Capillary refill	Normal	Prolonged	Prolonged; minimal
Extremities	Warm	Cool	Cold; mottled; cyanotic
Urine output	Normal to decreased	Decreased	Minimal

Pharmacologic Therapy

Antimicrobial Agents

Antibiotics are not indicated in cases of uncomplicated or viral acute gastroenteritis and may actually cause harm. Antimicrobial agents may increase the risk of prolonged carrier stage and relapses in nontyphoid Salmonella infections. Furthermore, treating gastroenteritis due to Shiga toxin producing Escherichia coli with antibiotics may increase the risk of hemolytic-uremic syndrome. The use of antibiotics is reserved for the treatment of acute enteritis complicated by septicemia and in cases of cholera, shigellosis, amebiasis, giardiasis, and enteric fever [28,29].

Antidiarrheal Agents

Antidiarrheal drugs are not recommended for routine use because of the risk of their adverse effects. Antimotility agents, such as loperamide, are known to cause opiate-induced ileus, drowsiness, and nausea in children younger than age 3 years. Conversely, agents such as bismuth subsalicylate have demonstrated limited efficacy in treating acute gastroenteritis in children. Racecadotril, an enkephalinase inhibitor that decreases the intestinal secretion of water and electrolytes without effects on intestinal motility, has been studied in children in the inpatient setting with promising effects; however, the drug is not yet approved for use in the United States. Further well designed prospective studies of its efficacy and safety are needed [30].

Antiemetic Agents

The desire to alleviate vomiting arises from the need to prevent further dehydration and to avoid the need for IV therapy and subsequent hospital admission. Ondansetron, a selective serotonergic 5HT3 receptor antagonist, has shown to be an effective antiemetic agent, decreasing the rate of admissions in patients treated with a single dose in the emergency department with few adverse effects reported [31]. Older generation antiemetics such as promethazine, a phenothiazine derivate with antihistamine and anticholinergic activity, have been found to be less effective in reducing emesis. Promethazine is approved by the Food and Drug Administration only for children older than age 2 years and is associated commonly with adverse

effects such as sedation and extrapyramidal effects, which may interfere with the rehydration process. Metoclopramide, a procainamide derivate that is a dopamine receptor antagonist, has been proven to be more effective than placebo, but the rate of extrapyramidal reactions reported in association with its use is up to 25% in children. The use of these medications is not recommended routinely by the AAP or the CDC. None of these drugs addresses the causes of diarrhea, and the use of pharmacotherapy may distract the general care physician away from the mainstay therapy: appropriate fluid and electrolyte replacement and early nutrition therapy [32].

Supplemental Zinc Therapy

Zinc is an essential micronutrient that protects cells from oxidative injury. In cases of acute or chronic diarrhea, there is a significant loss of zinc due to increased intestinal output. Some clinical trials done in developing countries in which the prevalence of zinc deficiency is high have revealed a potential benefit from zinc therapy in conjunction with ORS therapy. The theory postulates that zinc may improve the absorption of water and electrolytes, although the exact mechanism of action is not understood completely. Studies comparing zinc supplementation with placebo have revealed a reduction in stool frequency and shortening of the duration of diarrhea. The addition of zinc to ORSs is now recommended by the WHO and the United Nations Children's Fund worldwide for the treatment of diarrheal diseases of children [3].

Functional Foods

Probiotics are live microorganisms in fermented foods that potentially benefit the host by promoting a balance in the intestinal flora. *Lactobacillus rhamnosus* GG, *Bifidobacterium lactic*, and *Streptococcus thermophilus* are the most common probiotic bacteria studied. Randomized controlled trials have particularly supported the efficacy of L rhamnosus GG in the treatment of acute infectious diarrhea, reducing the duration of the diarrhea by 1 day. When analyzing the different causes of diarrhea, Lactobacillus was more effective in treating gastroenteritis caused by rotavirus, with a reduction in duration of diarrhea of 2 days. Probiotics seem to be

more helpful when the therapy is started early in the presentation of illness in otherwise healthy patients who have viral gastroenteritis. Prebiotics, on the other hand, are oligosaccharides, rather than microorganisms, that stimulate the growth of intestinal flora. Randomized controlled trials studying prebiotics have failed to demonstrate a reduction in the duration of diarrhea in children; therefore, prebiotics are not recommended routinely [34].

Conclusion

Vomiting and diarrhoea can be nonspecific symptoms in children, and the diagnosis of GE needs to be made after excluding other causes. Children need to be assessed carefully for signs of dehydration. Children without dehydration can be managed at home and should be offered their normal fluids. Most infants and children can be rehydrated safely with ORS. Children with severe rehydration 1>7%1 require hospital admission and those with lesser degrees of dehydration require observation and early review to ensure rehydration is occurring appropriately.

Summary of important points：

- Diagnosis of acute gastroenteritis is made after a careful exclusion of other causes
- Dehydration is the most important complication.
- The best signs for identifying dehydration are decreased peripheral perfusion as evidenced by prolongation of capillary refill time, abnormal skin turgor and abnormal respiratory pattern.
- Children at high risk 1<6 months or significant comorbidity) should bereferred for pediatric care.
- Antiemetic and antidiarrheal are not indicated in children with acute gastroenteritis.

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