

'Review of Neonatal Calve diarrhea (Rotavirus) '

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Diarrhea numerate one of the most problems which affect the newborns (infants, calves, lambs kids, kittens puppies and foals) [1] diarrhea cause economic losses for livestock production, acute form lead to high mortality due to toxicity dehydration, blood acidosis and electrolytes imbalance, sub-acute form of diarrhea lead to loss body weight, retarded growth, and besides to cost of treatment[1]. There are many causes of diarrhea, non infectious causes like management, nutrition and colostrums intake, infectious causes, bacteria, viruses and parasites[2]. Corona virus, Rotavirus, E-coli, salmonella and cryptosporidium parvum most important causes of diarrhea in newborns in the world [3,4].

Diarrhea defined is increased frequency of defecation and abnormal excretion of feces which contain high concentration of fluid and low concentration of dry mater which results of increase fluency of intestine movement that is lead to reduce fluid absorption and cause watery to soft feces constancy, sometimes contain mucus or blood, have offensive odor and abnormal color according to pathogenic causes[1,5]. Also diarrhea consider symptom relevant to disease of digestive system [6,7].

Mechanisms of Diarrhea:

1. Osmotic diarrhea

There may be an osmotic effect when substances within the lumen of the intestine increase the osmotic pressure over a greater than normal length of intestine, resulting in an osmotic movement of an excessive amount of fluid into the lumen of the intestine. The fluid is not reabsorbed and accumulates in

the lumen. Examples include saline purgatives, overfeeding, and indigestible feeds, in cases of virus infection such as Rotavirus and Coronavirus or Protozoa like cryptosporidium osmotic diarrhea occurs due to shorting and adherences in villi of intestine and atrophy which leads to decrease the capacity of gut absorption.

2. Secretory Diarrhea

secretory-absorptive imbalance results in a large net increase in fluid secretion with little if any structural change in the mucosal cells. The enterotoxin elaborated by enterotoxigenic E. coli results in intestinal hypersecretion. The villi, along with their digestive and absorptive capabilities, remain intact. The crypts also remain intact; however, their secretion is increased beyond the absorptive capacity of the intestines, resulting in diarrhea.

3. Abnormal intestinal motility

Hyper excitability, convulsions and the stress of unexpected sudden confinement may result in diarrhea, which may be due to increased peristalsis, resulting in 'intestinal hurry' and reduced intestinal absorption due to rapid passage of intestinal fluids in an otherwise normal intestine. This can occur in animals that are being assembled for transportation and during transportation[1].

4. Exudative Diarrhea

Acute or chronic inflammation or necrosis of the intestinal mucosa results in a net increase in fluid production, inflammatory products, including loss of serum proteins, and a reduction in absorption of fluids and electrolytes. Examples include many of the diseases associated with bacteria, viruses, fungi, protozoa, chemical agents and tumors. The classic example is enteric salmonellosis, in which there is severe inflammation with the production of fibrinous, hemorrhagic enteritis example bovine virus diarrhea and inorganic arsenic poisoning.

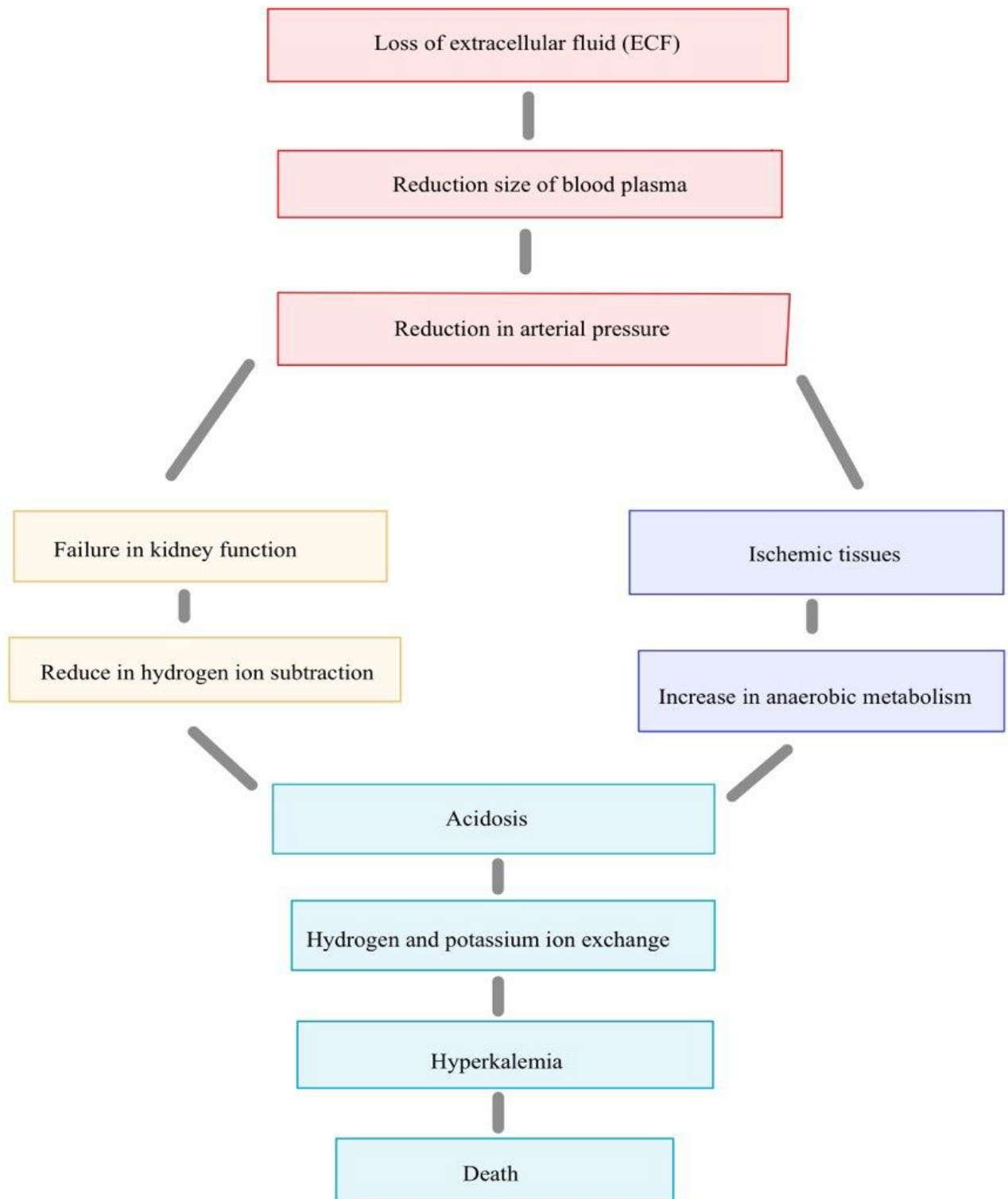


Figure 1: Pathophysiologic effects of diarrhea and dehydration in newborns calves [6]

Classification of Diarrhea:

Diarrhea classified according to duration period

Acute diarrhea:

Occur suddenly in form of acute and frequent episodes in short duration, fecal material in acute diarrhea characteristic by Watery constancy leading to dehydration ,coma and death [8]. Acute diarrhea causes in newborn calves *E-coli* ,*Rotavirus* and *Coronavirus* [1].

Chronic Diarrhea:

This type occurs due to turning of acute diarrhea to chronic form which continues for several weeks or months, occurs in form of recurrent episodic leading to gradual significant loss body weight then emaciation[8].

Infectious Newborns calves diarrhea

Infectious Agents: The illustration of infectious causes of newborns calves diarrhea has been a major area of progress over the last 30 years. Salmonellas were be the only causative agent of newborns calves diarrhea known for many years.

In 1967 discovered small number of strains of *E-coli* caused a watery diarrhea and laterally known as enterotoxigenic *E-coli* *Rotavirus* was the first virus caused newborns calves diarrhea discovered followed by *coronavirus* also *cryptosporidium parvum* was found as a causative agent of newborns calves diarrhea[6].

Rotavirus

Bovine rotavirus is the most important virus agent of diarrhea in newborn calves. rotavirus mostly affect young animals specially calves with 4weeks [9]. Rotaviruses belong to the family of Reoviridae, genus Rotavirus. The Icosahedral non-enveloped viruses possessing genome is composed of 11 double-stranded RNA (dsRNA) segments that encode six viral structural proteins (VP1 to VP4, VP6, and VP7) and six nonstructural proteins (NSP1 to NSP6) [10].

Among them, NSP4 acts as a viral enterotoxin exerting both secretory and subsequent anti-secretory actions which result in moderate loss of Cl⁻ into the intestinal lumen at the onset of BRV diarrhea [11]. There are eight species of this virus, referred to as A, B, C, D, E, F, G and H(12).

Morphology

[13] reported rotavirus initially in Australia. The virus was discovered via direct election microscopy visulation in the duodenal biopsies of child with acute diarrhea and named duovirus. virus was named rotavirus because of its characteristic wheel-shaped (rota is a Latin word which means wheel) morphology when seen under an electron microscope [14] The virion consists of a triple layer capsid covering a genome of double stranded RNA The mature infectious virion has a diameter of 100nm.

The lipid-free envelope consists of three concentric layers of protein. The different layers are made up of three of the 13 proteins that the rotavirus genome encodes.

VP2 forms the innermost layer and surrounds the viral dsRNA. The middle layer is composed of VP6 and the outermost layer of VP4 and VP7. The middle and outermost layer have 132 large channels that link the outside of the virion to the VP2 layer. VP7 makes up the base of the outermost layer while VP4 forms spike like extensions extending out of the virion. VP4 also extends in through the two outer layers, and possibly also have some interaction with the VP6 layer. Both have important roles in the infectivity of the virion. Infectivity is quickly lost in the presence of disinfectants like chlorine and 95% ethanol. These remove the outer shell and thus make the virus unable to infect cells. The virus is stable and infectious in pH range between 3-9 and may under the right concentration of calcium chloride stay infectious for months at 4°C and even up to 20°C [15].

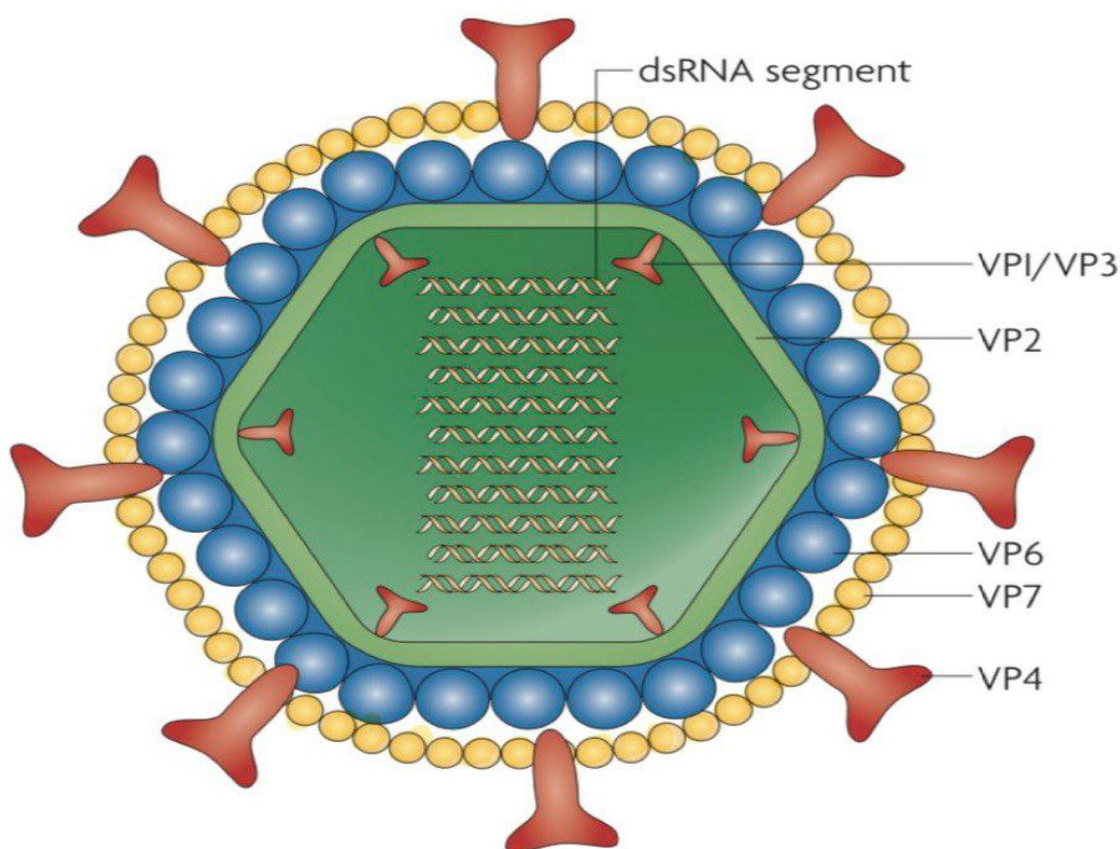


Figure 2: Rotavirus. The figure shows a schematic representation of a rotavirus virion. Source: (16)

Rotavirus transmission

Rotavirus infect wide range of mammals and birds. The virus transmitted to calves through a fecal-oral route and via contact with other infected calves, also infected primarily or secondary through infected objects, feed and water calves can also be infected by virus shed via dam during the birth [17].

The infected calves shed virus through the feces from the second day of infection and the shedding may last for 7-8 days. virus primarily affects neonatal individuals, and calves more than 3 months of age are usually not affected [18]. Rotavirus epidemics exhibit a seasonal pattern [19] In temperate climates, rotavirus infections peak in the winter months. Bovine rotavirus infection occur in neonatal calves between 1-30 days of age [20,21].

The virus survives in feces for several months in rearing pens and barns; and being resistant to many disinfectants, contribute to the persistence of infection [22].

Prevalence of Rotavirus :

The prevalence of rotaviral infection in calves varies depending on the country and region under study [20,1]. many researchers have described the incidence and prevalence of the infection in calves ranging from 7–98% even though the average rate should be considered as 30–40%. In Italy [16.8%, ELISA] [23], France [45.1%, ELISA] [24], Ireland [91%, ELISA] [25], Turkey [41.2%, ELISA] [26], Brazil [19.4%, ELISA] [20], Argentina [62.5%, RT-PCR][27] and Switzerland [46%, ELISA] [28].

In Iraq Rotavirus detected in fecal samples of Cattle and buffaloes calves in Baghdad by using agar gel precipitation [29].

In Basrah province rotavirus detected in calves, infection rates was (30.7%) in last studies [30].

Pathogenesis

Calves who infected via *Rotavirus* often suffer of sever and life-threatening diarrhea. The virus replicates in small intestine precisely in mature enterocytes on villi, lyses occurs as a result to viral replication[31]. The mature enterocytes which lyses replaced by immature enterocytes from crypts of the villi.

The balance between absorption and secretion of fluid then is changed leading to accumulation of fluid in the small intestine [32], also systematic insufficiency of bicarbonate, sodium, chloride, potassium and water occur as a result to loss of mature enterocytes, that's leading to acidosis, also lose of mature enterocytes induce reduction of milk digestion ability, undigested milk is fermented by micro flora, that's contributes to cause acidosis[18], and low lactase enzyme occur due to loss mature enterocytes, in the intestinal lumen further contributes to fluid accumulation by a failed osmotic regulation [33]. The recent study referred to the viral protein NSP4 which act like enterotoxin. When cell lyses happens the protein bind to cells and causes secretion of chloride into intestinal lumen, resulting in osmotic diarrhea [15]. Histologically there's shorting and blunt villi in the small intestine. The columnar epithelial cells are substituted by cuboidal or squamous cells from the crypts and infiltration of inflammatory cells in the lamina propria is seen [34]. the extra-intestinal lesions in mesenteric lymph nodes were also correspond with the previous researchers, who described the decline of lymphocytes from germinal centers of lymphoid follicles of mesenteric lymph nodes and detection of rotavirus antigen via direct immunofluorescence technique in calves [35,36].

Clinical signs

The results of clinical examination of infected calves referred to diarrheic calves suffered from depression, loses appetite ,and some calves were recompensed ,also there were differentiation in rectal

body temperature, respiratory rate and heart rate, the previous clinical signs is most important clinical signs accompanied with diarrhea which lead to dehydration and metabolic acidosis in newborn calves [6]. Dehydration and reduction of vascular fluid effect on tissues metabolism that's leading to muscle weakness ,anorexia and hypothermia [1]. Dehydration and metabolic acidosis in diarrheic calves lead to increasing in the rectal body temperature due to lack body efficiency to elimination of excess heat which result by evaporation normally Then decrease in body temperature as well as the metabolic acidosis have a stimulating effect on the sympathetic nervous system so that's leading to elevated in heart rate (tachycardia). When hypovolemia occurring frustration to Respiratory centre [6]. The increased respiratory rates with labored respiration may be attributed to the decrease of blood pH that stimulated respiratory centers in the medulla oblongata, leading to increase in the depth and rate of respiration(hyperpnoea) to eliminate the excess of carbon dioxide[38,39].



Figure 3: Clinical manifestation of infected calves show dehydrated, weak and emaciation



Figure 4: Clinical manifestation of infected calves show recumbent and dehydrated calves.



Figure 5: Clinical manifestation of infected calves show milky color with mucus of fecal material in infected calves.

Clinical pathology

The results showed significant increase in PCV and haemoglobin, this elevation is important indicator for dehydration and metabolic acidosis which resulting due to diarrhea leading to increasing in hemoconcentration this elevation of hemoconcentration lead to increase viscosity of the blood then reduce in the blood arrival deferent body tissues [6].

The increases of Hb, PCV may be resulting to dehydration and the reduction of water content in the vascular space [40,41].

Thus, estimation PCV is important to monitor hydration status of animal and used as indicator for dehydration severity in diarrheic calves. There were significant increase in WBC count in infected calves due to elevation of lymphocytes and monocytes as a defense mechanism against the virus, this result agree with [18,42]. [43] referring to diarrhea leads to an electrolyte imbalance and dehydration that is fecal-loss of electrolytes and increased intestinal-loss of water and nutrients and nutrients.

hyponatremia and hypo- or hyperkalemia occur in diarrheal calves based on the acute or chronic stage of the infection [44]. Potassium is lost in urine and feces during diarrhea. In response to metabolic acidosis which occur due to diarrhea K shifts from the intracellular fluid into extracellular fluid leading to potassium elevation [45].

Prevention and control

The incidence of rotavirus infection can be reduced by improving sanitation and hygiene at the birth, feeding space, housing and general handling of the calves, calves take adequate amounts of colostrum of good quality and appropriate diet [37]. Reduce the secondary bacterial infection which increase the risk of rotavirus infection [46].

Vaccination, The vaccine given to the dam in last stage of pregnancy that's leading to high level of antibodies in the colostrum, The main effect of antibodies is presented in the lumen of small intestine while antibodies in the bloodstream seem to have little effect on preventing the symptoms of disease [18].

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