Neonatal Calf Mortality - An Overview

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Diseases of the new born calf and neonatal calf mortality are the major causes of economic losses in livestock production. It is roughly estimated that a calf mortality of 20% may reduce net profit to 40% (Blood and Radostits, 1989). Neonatal calf mortality varies from 12.5 to 30% in India (Verma et al., 1980). Neonatal calf mortality in the first month of age is accounted to be 80-85% of the total mortality and is particularly high in the third week of life. Mortality in neonatal calves have been mostly attributed to infectious agents, i.e. rotavirus, coronavirus, enteropathogenic Escherichia coli, Salmonella species and cryptosporidium (Snodgrass et al., 1986). Other important causes of calf mortality include immunodeficiency (White and Andrews, 1986), season effects (Fink, 1980), difficult parturition (Ahmad et al., 1986) and faulty management conditions (Fedida et al., 1985). The aim of this paper is to review the role of infectious and non-infectious agents in neonatal calf mortality in cows and buffaloes.

Infectious Causes
Calf Diarrhea
One of the major cause of neonatal calf mortality is diarrhea. Diarrhea in young calves is a syndrome of great etiological complexity, in addition to the influence of varied environmental, nutritional, physiological and management factors. The infectious agents capable of causing diarrhea in the neonatal calf which include rotavirus, coronavirus, enteropathogenic E. coli, Salmonella species and cryptosporidium (Snodgrass et al., 1986) out of which the most frequently encountered are rotavirus and enteropathogenic E. coli (Morin et al., 1976). Although campylobacters are normal flora of ruminants, they also lead to enteritis in calves.

Etiology of diarrhea
Rotavirus
Surveys on rotavirus as causative agent of neonatal calf diarrhea revealed 9.0 to 93.7% and some times up to 100% affection. Rotavirus has an important etiological role in the neonatal calf diarrhea and mainly found in feces of diarrheic calves up to 3rd week of life. In 1971, Mebus et al. first time mentioned that a viral agent is also involved in neonatal calf diarrhea. They demonstrated that the virus specially attacks the epithelium of small intestine of young calf. The virus replicates in intestinal epithelial cells near the tips of villi. Infected cells are desquamated. As epithelial cells are lost from the tips of villi, the desquamated cells are replaced by cuboidal cells, followed by flattened squamous epithelial cells.

Coronavirus
Stair et al., (1972), first time reported role of coronavirus in neonatal calf diarrhea. They demonstrated that virus has an affinity for epithelial cells of the villi of the small intestine. Replication of the virus in these cells is accompanied by loss of epithelium and blunting of the villi. In the colon, surface epithelial cells are also attacked, with loss of surface cells and cystic dilation and accumulation of cellular debris in underlying crypts (Mebus et al., 1973). Later on role of coronavirus in neonatal calf diarrhea was confirmed by Mebus et al. (1975). Incidence of coronavirus in neonatal calf diarrhea is slightly lower than rotavirus.

Enterotoxigenic Escherichia coli
Enterotoxigenic Escherichia coli (E. coli) produces severe diarrhea in calves mainly during the first
two weeks of life (Barrandeguy et al., 1988) and even some reports are available that the highest frequency of *E. coli* occurs in calves younger than 3 days old (Snodgrass et al., 1986). *E. coli* produces enterotoxic and septicemic colibacillosis in young calves (Jones and Hunt, 1983). In enterotoxic colibacillosis, the pathogenic *E. coli* adhere to the mucosa and proliferate in the lumen of intestine, producing a potent enterotoxin, which stimulate excessive secretion of fluid from intestinal mucosa (Moon, 1974). This loss of fluid causes diarrhea and often leads to dehydration and high rate of death in the neonatal calves. In septicemic colibacillosis, the organism invades the host through the oral cavity, respiratory system, pharynx, or umbilicus and produces an endotoxin that causes the lesions. Unless the enterotoxic form occurs simultaneously, the bacteria do not reach to the small intestine, thus diarrhea or intestinal lesions do not occur (Jones and Hunt, 1983). Calves that are deficient in immunoglobulins are mostly susceptible to this form of colibacillosis (White and Andrews, 1986). The signs and lesions are typical of bacterial arthritis, polyserositis, meningitis and pyelonephritis with bacterial emboli and necrotizing, purulent, or fibrinous exudate (Wray and Thromlinson, 1974). Incidence of *E. coli* in calf diarrhea varies very widely. Different strains of *E. coli*, are prevalent in diarrheic calves, mostly K 99+ antigen was possessed by *E. coli* involved in neonatal calf diarrhea (Nagy et al., 1986).

Salmonella
Salmonella infections are most frequent and of great concern to young animals. These rod-shaped, gram negative organisms are usually motile and produce gastroenteritis with nausea, vomiting, cramps and diarrhea (Jones and Hunt, 1983), salmonella in neonatal calves (28 days old) produces diarrhea in 1-12 % calves and morbidity up to 20 %.

Cryptosporidium
Cryptosporidium occurs in diarrheic calves and more than 10 per cent of all the scouring calves excrete cryptosporidia at the same time as rotavirus (Snodgrass et al., 1986). In tissue sections of small intestine basophilic organisms are found embedded in microvilli of intestinal epithelial cells (Trigo et al., 1982).

Pneumonia: - Pneumonia is a very common problem affecting calves leads to great economic losses and death. Two types of pneumonia are seen very frequently which are proliferative and exudative in calves (Trigo et al., 1982).

Etiology of pneumonia
The causative agents obtained from nasal swabs of calves suffering from pneumonia or lung tissues from calves died of pneumonia were: *Pasteurella multocida*, *Pasteurella hemolytica*, *Streptococi*, *Pseudomonas aeruginosa*, *Mycoplasma bovis*, *Corynebacterium pyogenes*, *E. coli* (Trigo et al., 1982; Taoudi et al., 1983). Coronavirus (Wellemans et al., 1985). Herpesvirust and pestivirus (Haralambiev et al., 1987) were the viruses isolated from pneumonic lungs of calves. Enzootic pneumonia commonly known as calf pneumonia is a disease complex may be called viral pneumonia because it is thought to begin with acute infection by Parainfluenza-3 (PI-3) virus, Bovine respiratory syncytial virus (BRSV) or possibly one or more several other (Adenovirus, BHV-1, reovirus, rhinovirus etc.) clinically it is usually characterized by mild respiratory distress but may be severe as in virulent BRSV infection which may lead to severe dyspnea and mortality.

Non-Infectious Causes Immunoglobulin
Immunoglobulins are acquired by the offspring through the colostrum. In colostrum, immunoglobulins present are IgG1, IgM, IgA and IgG2, however, IgG1 is predominant representing 80% of the total immunoglobulins absorbed by the neonatal calf (Blom, 1982). Immunoglobulins of the colostrum absorb into the circulation from the small intestines of the neonatal calf by a process micropinocytosis (Blood and Radostits, 1989). Maximum absorption occurs within the first 6-8 hours after birth (Blom, 1982). The amounts of antibodies from individual female shows differences due to breed, nutritional status and parity. Season, geography, and sex is also known to influence passive transfer of colostral immunoglobulins in calves (Sangwan et al., 1985).
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During absorptive period, competition between microorganisms and immunoglobulins does occur for intestinal receptors for transportation to the circulation. Intestinal bacteria produce malabsorption syndrome by occupying immunoglobulins receptors resulting in hypo or agammaglo-bulinemia in neonatal calves (Snodgrass et al., 1986). Colostral immunoglobulins present in the intestine and subsequently absorbed into the circulation protect neonatal calves against enteric and respiratory diseases and even from leg injuries (Norheim et al., 1985). High mortality and morbidity due to diarrhea, pneumonia and other diseases occurs in immunodeficient calves (Braun and Tennant 1983). Calves without adequate circulating IgG, are four times more likely to die and twice as likely to become ill as calves with adequate circulating immunoglobulins (White and Andrews 1986).

**Season**
Season has a significant effect on the calf mortality (Fink, 1980) as well as on the absorption of immunoglobulins in neonatal calves. In temperate climates the mean serum IgG, concentrations were lowest in winter born calves and increased during the spring and early summer (Norheim et al., 1985), perhaps this is the reason that higher mortality rates of 69.6 and 15.36 per cent had been observed in winter born buffalo calves than 39.4 and 5.97 per cent in summer born calves (Sharma et al., 1984).

**Parturition problems and parity**
Dystocia in the dams increases the rate of mortality in neonates. About 50 % calves are lost at parturition due to dystocia (Bellows et al., 1987). Dystocia is mainly due to abnormal presentation of calf especially backward and breech presentation. Incidence of dystocia is higher in primiparous dams than in multiparous dams and is also significantly higher when the calf is male (57.6%) but lowered (42.4%) when the calf is female (Patterson et al., 1987). Persistent hymen in heifers is an important condition which delays the delivery of the young one in naturally bred heifers (Ahmad et al., 1986). According to Jenny et al. (1981) stillborn calves are more likely to die as compared to normal delivered calves. Stillbirths vary with the parity of the dam (Simensen, 1982) and season of the year. In primiparous cows and during winter, stillbirths were higher than in multiparous cows and summer season. There is another factor i.e. sex which increases the rate of stillbirths in male calves (Szenci and Kiss, 1982). As parturition problem decreases with age and parity of the dam, the amount of colostrum available and concentration of colostral immunoglobulins increases (Sangwan et al., 1985). The immune status is better in calves from multiparous than primiparous cows. When there is better immune status of calf, its survival will not be affected by the gastrointestinal or respiratory diseases.

**Sex and birth weight of calf**
Mortality is higher in male (25.0%) than in female (13.9%) neonatal calves (Kaushik et al., 1980), reason for this higher mortality might be due to serum immunoglobulins, required for the protection from different diseases during neonatal life which absorb less in male (20.69 mg/ml) than female (25.12 mg/ml) calves (Sangwan et al., 1985). Competition between microorganisms and immunoglobulins for a common intestinal receptor does occur in early few hours of life (Staley and Bush, 1985), due to this competition male calf become more immunodeficient than female calves; therefore, male calves are more prone to bacterial diseases than female calves (Kaushik et al., 1980). Stillbirths as well as dystocia problems are more common when calve is male (Patterson et al., 1987). The birth weight had a significant effect on mortality. Calf mortality decreases gradually with increase in birth weight (Singh et al., 1980).

**Management and miscellaneous factors**
In calf houses, poor ventilation, overcrowding, no regular cleaning and disinfection predispose various diseases of calves, especially of respiratory tract leading to high calf mortality (Fedda et al., 1985). Tympamy and milk indigestion also play an active role in the neonatal calf mortality. Absorption of immunoglobulins continues up to 48 hours in calves, but maximum absorption occurs within the first 6-8 hours of life (Blom, 1982), if feeding of colostrum is delayed from this period,
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it results in hypo or agammaglobulinemia in calves (McGuire et al., 1976). Compared to hand feeding, suckling is a greater source of absorption of colostral immunoglobulins, therefore, it is generally recommended to allow calf to suckle its mother for the first two days of postpartum. Calves kept in pens develop arthritis, tenosynovitis or abscesses and even fractures and those develop as naval joint illness had a poor survival rates (Britney et al., 1991). Mortality of calves can be reduced by rearing them on elevated and perforated floors. Similarly naval disinfection and removal of mucous from the mouth and nose reduces mortality and morbidity rates in calves (Fink, 1980).

References


