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Pregnancy Toxaemia in Goats: A Review

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Introduction

Pregnancy Toxaemia is a common pre-parturient metabolic disorder of small ruminants characterised by hypoglycaemia and hyperketonaemia in last few weeks of pregnancy (about 2-3 weeks before parturition). Pregnancy Toxaemia is characterized by nervous and toxaemic signs followed by death of pregnant doe with twins or triplets or quadruplets, which is a huge economic loss to the farmer. The incidence of Pregnancy Toxaemia is more common in sheep associated with high morbidity and mortality than goat.

Synonyms – Pregnancy Ketosis, Gestational Toxemia, Kidding sickness, Ovine Ketosis, Twin lamb disease (later terms of used for sheep).

Key words: Ketosis, BHBA, Propionic acid, Negative Energy Balance.

Discussion

Aetiology – Hypoglycaemia along with Hyperketonaemia in terminal pre parturient goat reared with severe negative energy balance (Low plane of nutritional status)

Predisposing factors –

- Age and Parity,
- Breed,
- Transport & other stressors,
- Multiple foetus,
- Poor nutritional status,
- Obesity and lack of exercise,
- Unpleasant weather, Ex// famine & floods (causing feed deprivation),

- Intense rearing,
- Silage feeding,
- Cobalt deficiency,
- Inanition due to infection or concurrent disorders.

Animal factors - Insulin resistance which make the animal more susceptible to Pregnancy toxaemia as animal can't handle glucose fluctuations.

Classification (by O. M. Radostits *et al.*, 2007)

The following classification of pregnancy toxaemia is according to cause as the determination of the management cause is critical to control and prevention. These are further described below.

- Primary pregnancy toxaemia
- Fat ewe pregnancy toxaemia
- Starvation pregnancy toxaemia
- Secondary pregnancy toxaemia
- Stress-induced pregnancy toxaemia.

Negative Energy Balance

Negative energy balance is the main leading cause to the several metabolic disorders in the ruminants. Energy balance is the key for the proper metabolism and homeostasis for any animal. Energy status of animal depends upon feeding plane and utilisation of metabolites. When the Doe is pregnant with multiple foetus the space in the abdomen and the capacity of the rumen decreases (it will be further decreased by the abdominal fat, if the animal is highly obese [Estate Ketosis], this is very common in sheep than goat). With the rumen with decreased capacity accompanied by poor quality input of feed, which is insufficient to maintain both the doe and the growing foetus leads to energy deficit. This shift in energy balance termed as Negative Energy Balance (NEB).

This shift is due to decreased propionic acid synthesis due to insufficient or poor feed lead to decrease in the blood glucose level (Propionic acid is the precursor for the glucose) forcing the animal to undergo gluconeogenesis followed later by ketogenesis (fat catabolism).

Pathogenesis -

When the animal is in a state of negative energy balance, it hydrolyses fats to glycerol and fatty acids. Glycerol is converted to glucose while the fatty acids are metabolized for energy. The oxidation of fatty acids in the face of declining oxaloacetate levels (required for normal Krebs cycle function) results in the formation of ketone bodies (acetone, acetoacetic acid, and β -hydroxybutyric acid), thus causing the condition ketoacidosis (Margaret L. Delano *et al.*, 2002). Increase in serum un-esterified or free fatty acids leads to decrease cell immune and humoral response.

Primary Pregnancy Toxaemia: This is the most common manifestation and results in most flocks from a combination of a fall in the plane of nutrition during the latter half of pregnancy often coupled



with a short period of food deprivation in conjunction with a management procedure in late pregnancy such as crutching, shearing, change of environment, or drenching (O. M. Radostits *et al.*, 2007)

Secondary Pregnancy Toxaemia: Presence of concurrent metabolic or systemic disorders / infections lead to anorexia, inanition and negative energy balance causing secondary pregnancy toxaemia

Case Fatality Rate (CFR) – Reach up to 100% if proper diagnosis and treatment was not given to doe in correct time.

Clinical and Biochemical Changes -

- Glucose (hypoglycaemia), Ketone Bodies (hyperketonaemia); The glucose level is less than 2mmol/L and urine ketone level will be elevated more than 0.7mmol/L (Ajaz Quadir *et al.*, 2017).
- BHBA (beta-hydroxy butyric acid) levels will be highly elevated. Values above 0.8 mmol/L or above considered positive for pregnancy toxaemia.
- Elevated non-esterified fatty acids level
- Calcium (hypocalcaemia), Decreased calcium level in pregnant does due to the high need of calcium for fetal skeleton development during the late stage of pregnancy (Hefnawy *et al.*, 2011)
- Decrease in Phosphorus levels (hypophosphatemia)
- Other minerals: Hypokalaemia, Hypomagnesaemia, Hyperchloredemia (V Vijayanand *et al.*, 2021).
- Blood pH: Pregnancy toxaemia is often accompanied by acidosis, which may be associated with elevated unmeasured strong ions in goats (Gomez D.E *et al.*, 2020).
- Liver enzymes panel: Elevated ALT, ALP, GGT, LDH indicate hepatic damage.
- Kidney panel: Increased BUN and creatinine attributed to severe kidney dysfunction accompanied with acidosis which is the result of increased ketone body in general circulation. There was fatty infiltration in tubular epithelium of kidney in pregnancy toxaemic goat leads to elevation of both parameters (Vasava PR *et al.*, 2016).
- Serum Cortisol: highly elevated.

The cortisol concentration has a strong positive correlation with BHBA and FFA and also was negatively correlated with the concentration of glucose and insulin. (A. A. Affana *et al.*, 2022)

- Cardiac biomarkers: Elevated according to L.M. Souza *et al.*, 2020.
- Haematology – lymphopenia due to toxic inhibition of T-lymphocyte proliferation due to Elevated BHBA. Cortisol-induced changes in the hemogram (neutrophilia, lymphopenia, eosinopenia) and evidence of dehydration (elevated hematocrit and total protein) can be expected. (Mary C. Smith and David M. Sherman., 2009)
- Amino acids: [Note: subclinical pregnancy toxemia (SPT), clinical pregnancy toxemia (CPT)]

In goats with CPT and SPT, the concentration of valine, one of the gluconeogenic amino acids, was significantly higher than in control group ($p < 0.001$), while histidine concentration was



significantly lower ($p < 0.020$) than in control group. Specifically in goats with CPT, the concentrations of alanine ($p < 0.002$), serine ($p < 0.001$), and threonine ($p < 0.043$) were significantly lower than in control group. Moreover, the concentration of phenylalanine, which is both a glycogenic and ketogenic amino acid, was significantly lower ($p < 0.028$) in goats with SPT compared to the control group. The Fisher ratio ($p < 0.010$) and Glycine/Alanine ratio ($p < 0.001$) were significantly higher in pregnancy toxemia goats with than in control group goats, indicating a poor nutritional and energy status of the goats during the prepartum period. (Uztimür, M *et al.*, 2024)

Clinical signs - Usually non-specific;

The initial clinical signs include anorexia (primary sign) followed by separation from the flock, decreased responsiveness, bruxism, altered gait and urination pattern, decrease milk production, scanty faces, head pressing and blindness. Later followed by *nervous signs*; tonic-clonic seizure episodes, decreased muscle tone and stiffness of neck muscles, star gazing behaviour, lateral linking of head, sluggish reflexes, circling and tremors of head muscles causing jaw champing and salivation. The above signs are followed by recumbence, and death (in one week).

Hyperketonaemia makes the animal breath fruity in odour. Nervous Signs are attributed to cerebral lesions induced by hypoglycaemia. Toxaemia signs will be noticed due to the death and putrefaction of foetus in-utero. Death occurs due to cerebral hypoglycaemia, liver and renal dysfunction.

Post-mortem Lesions - Death of pregnant doe (Final stage of pregnancy) on post mortem reveals the presence of multiple decomposing foetus inside the atone uterus carcass look severely dehydrated, minimal fat and Toxaemia signs can be evinced. Lungs shows congestion, Liver will be pale and friable shows fatty changes. Liver histopathology reveals distended hepatocytes with fat globules infiltration.

Sequalae - Even if animal Recovers from pregnancy toxemia, the dystocia may occur due to the loss of uterine tonicity.

Prognosis – Depends on the time of veterinary intervention, diagnosis and effective treatment. Early intervention can have better prognosis once the animal is recumbent the chances of full recovery is very low.

Prognostic markers: Fructosamine, creatinine, potassium, lactate dehydrogenase and malondialdehyde are the best prognostic indicators of pregnancy toxemia. (Iqbal R *et al.*, 2022).

According to Iqbal R *et al* (2022), When fructosamine levels are below 0.02 mMol/L, ewes have an almost 98% chance of dying, which makes fructosamine a good diagnostic indicator, as well as a good prognostic indicator. (This fructosamine levels and prognosis can be correlated even for goats).

Diagnosis -

1. Based on history, breeding season, pregnancy and the clinical signs (tentative diagnosis).



2. Estimation of serum glucose levels (Decreased) can be diagnosed by enzymatic estimation or by using glucometers.
3. Estimation of serum BHBA levels (elevated) and cortisol levels (elevated).
4. Urine reagent strips or Rothera's test can be done to detect ketone bodies in urine.
5. X-ray or ultrasound reveals pregnancy often with the multiple foetus.

Differential Diagnosis: Pre-parturient hypocalcaemia and Hypomagnesaemic tetany

Economic Importance - Pregnancy toxaemia causes severe emotional and financial loss to the farmers besides losing the healthy and fertile doe, farmer also lost almost grown and to be delivered foetuses. Even if the doe survives and recover from the ketosis; dystocia, severe metabolic disturbances, RFM, metritis may occur along with the early neonatal mortality. This lead to severe capital loss to farmer by feed and treatment cost.

Treatment -

If BHBA levels are tested and pregnancy toxaemia is discovered in the early stages, it can be countered with the feeding high energy concentrates along with the drenching Propylene glycol. Propylene glycol is given orally by dosing syringe, at the rate of 60 ml two or three times daily as a glucose precursor. Overdoses of propylene glycol can be fatal, creating plasma hyper osmolality that impairs neurologic function. (Mary C. Smith and David M. Sherman., 2009). Besides propylene glycol, glycerine also can be used. Co-administering B complex vitamins supplements should be done (Niacin suppress the lipolysis).

Once signs are already started and brought to Physician;

- Fluid therapy with the dextrose solution (5% ,10%) should be given.
- One recommendation for glucose therapy is the administration of 5-7 g of glucose I.V 6-8 times a day in conjunction with 20-40 units of zinc protamine insulin given I.M every other day for 3 days. (Martenuik JV et al., 1988 and O. M. Radostits et al., 2007).
- Metabolic acidosis can be counted by administrating Ringer's lactate.
- Administering Lipotropic substances such as choline chloride, acetyl-methionine, vitamin B12, etc. which facilitates liver elimination of triglycerides (Bonino et al., 1987).
- Foetus should be removed by emergency C-section in early stages so that the stress to the dam to provide nutrients and energy to the foetus decrease and can recover better from ketosis.
- Induction of parturition can be done in early stages using corticosteroids which is not useful in the latter stages.

Prevention and Control

Proper Management of herd, dividing the flock based on body score, health and physiological status (farmer alone can be done or with the help of veterinarian) and providing balanced diet. Visit to the veterinarian following breeding season to get pregnancy check-up, based on the pregnancy and



number of foetus farmer can increase in the plane of nutrition and providing high quality feed to the goat. Thus providing required energy to both doe's maintenance and the foetus growth. This leads to not only in eutocia, producing healthy foetus but also in procuring profits.

Compton's metabolic profile testing and serum BHBA, NEFA levels can help can help in early diagnosis and prevention of pregnancy toxemia, irreversible brain injury and death of Doe. Feeding Niacin and methionine amino acids to the goats of late gestation plays a protective role on pregnancy toxemia (Mustafa Kemal SARIBAY *et al.*, 2020)

Conclusion

Pregnancy toxemia highly fatal metabolic disorder of goats that can be prevented from happening in the flock and losses to the farmers by simple changes in the feeding plane of nutrition and awareness. To achieve that extension activities by the veterinarians should be done and awareness to farmers is very important in rural areas.

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