

Lecture-1

Keto acidosis

Ketoacidosis is a metabolic acidosis due to an excessive blood concentration of ketone bodies (acetone, acetoacetate and beta-hydroxybutyrate). Ketone bodies are released into the blood from the liver when hepatic lipid metabolism has changed to a state of increased ketogenesis. The abnormal accumulation of ketones in the body occurs due to excessive breakdown of fats in deficiency or inadequate use of carbohydrates. It is characterized by ketonuria, loss of potassium in the urine, and a fruity odor of acetone on the breath. Untreated, ketosis may progress to ketoacidosis, coma, and death. This condition is seen in starvation, occasionally in pregnancy if the intake of protein and carbohydrates is inadequate, and most frequently in diabetes mellitus.

Different Types of Ketoacidosis

Diabetes Keto Acidosis (DKA): Due to lack of insulin glucose uptake and metabolism by cells is decreased. Fatty acid catabolism increased in resulting in excess production of ketone bodies.

Starvation Ketosis: Starvation leads to hypoglycemia as there is little or no absorption of glucose from intestine and also due to depletion of liver glycogen. In Fatty acid oxidation leads to excess ketone body.

Bovine Ketosis

Introduction

- Bovine ketosis occurs in the high producing dairy cows during the early stages of lactation, when the milk production is generally the highest.
- Abnormally high levels of the ketone bodies, acetone, acetoacetic and beta-hydroxy butyric acid and also iso- propanol appear in blood, urine and in milk.
- The alterations are accompanied by loss of appetite , weight loss, decrease in milk production and nervous disturbances.
- Hypoglycemia (starvation) is a common finding in bovine ketosis and in ovine pregnancy toxemia.
- In non-ruminants, liver is the sole source of ketone bodies.
- In ruminants, the rumen epithelium and mammary gland are also sources of ketone bodies production.

- Among the ketone bodies acetone does not ionize to the appreciable level, whereas, acetoacetic and β -hydroxybutyric acids will ionize readily.
- Acetoacetic and β -hydroxybutyric acid are more powerful acids than the volatile fatty acids.

Ketosis in Lactation

- During lactation plasma glucose is drained for the synthesis of lactose by the mammary gland.
- The two sources of plasma glucose are absorption from the gut and gluconeogenesis.
- In ruminants little glucose is absorbed from the gut.
- Most of the glucose is synthesized in the liver and in the kidney.
- The chief substrates are propionate, which is produced in high grain diet.
- When there is a mismatch between mammary drain of glucose for lactose synthesis and gluconeogenesis in liver, hypoglycemia will result.
- The condition leads to ketosis.

Underfeeding Ketosis

- This type of ketosis occurs when a dairy cow receives insufficient calories to meet the lactational demands plus body maintenance.
- This type is further divided into Nutritional Underfeeding Ketosis and Secondary Ketosis.
- The Underfeeding Ketosis
 - It occurs when the cow is given an insufficient quantity of feed or a diet with low metabolic energy densities.
- The Secondary Ketosis
 - It occurs in cows that have other disease like hypocalcemia, mastitis, or metritis, which suppresses appetite and prevents feed consumption.
 - This type of ketosis resembles starvation ketosis and the difference is that there is the additional caloric and glycemic burden of milk production.
 - There are at least three types of syndromes that occur in cows during lactation.
 - The syndromes are characterized by anorexia, depression, ketonemia, ketolactia, ketonuria, hypoglycemia and decreased milk production.
 - The three syndromes are underfeeding ketosis, alimentary ketosis and spontaneous ketosis.

Alimentary Ketosis

- This type of ketosis occurs when cattle have been fed spoiled silage that contains excessive amounts of butyric acid.
- The rumen epithelium has a high capacity to activate butyrate to acetoacetate and betahydroxybutyrate.
- When there is excess presence of butyrate, large quantity of beta hydroxybutyrate will be formed and released into the circulation with resulting ketosis.

Spontaneous Ketosis

- This is the most common form of ketosis and occurs near peak of lactation, that have access to abundant high quality feed, and that have no other diseases.
- The disease is not accompanied by severe acidosis and spontaneous recovery is common although there is a large decrease in milk production.

Hypoglycemic Theory

- The most widely accepted theory of bovine ketosis is the hypoglycemic theory.
- During lactation mammary gland might withdraw glucose from the plasma more rapidly than the liver can supply it, which leads to hypoglycemia.
- The hypoglycemia will lead to ketonemia as more of the LCFAs will reach the liver and oxidized. The net result of this is an increase in the level of ketone bodies.

Ovine Pregnancy Toxemia

- This syndrome occurs in pregnant ewes that are carrying more than one fetus and that have been subjected to caloric deprivation or stress.
- Susceptibility increases as ewes approach term because the fetal glucose demands increase with increasing body size.

The Laboratory Test

- Rotheras test is used as a qualitative test for ketone bodies.
 - The test is most sensitive for acetoacetic acid.
 - Acetone gives only a slight response, whereas b-hydroxybutyric acid is insensitive to this test.
 - A number of drugs (substances) having keto, aldehyde or sulfhydryl groups can also react with nitroprusside and give false positive result.