Hy-Line®

FATTY LIVER HEMORRHAGIC SYNDROME

DESCRIPTION

Fatty liver hemorrhagic syndrome (FLHS) is a noninfectious disease characterized by excessive accumulation of fat in the liver and abdominal cavity, causing liver rupture, hemorrhage and sudden death of hens[1]. Death is the result of internal bleeding.

FLHS occurs most commonly in egg-type layers in confinement cage housing. Affected flocks can experience significant economic losses from both bird mortality and decreased egg production[2]. In one epidemiologic survey, 40% of caged hen mortality was associated with FLHS. The same survey showed that FLHS can occur in cage-free housing systems, but at a lower rate than in cage systems. Total mortality due to fatty liver usually does not exceed 5%.

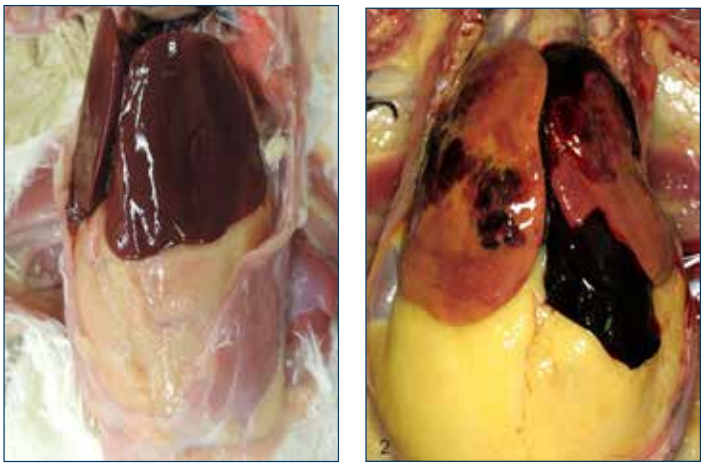

Figure 1a (left): Normal liver. Figure 1b (right): Fatty liver hemorrhagic syndrome. Large blood clots arising from the liver. Note the excessive abdominal fat.

PATHOLOGY

Hens in affected flocks are generally obese (overweight by 20% or more) and experience a sudden drop in egg production[3]. Dead birds often have a pale head, wattles, comb, or skin. Necropsy reveals livers that are enlarged, pale, soft, and engorged with fat. The excess fat in the livers makes them yellow, soft, and friable. The affected liver has lost structural integrity leading to a susceptibility for rupture and hemorrhage. The liver may easily break apart when handled. Large blood clots are found within the abdomen. The origin of the blood clot is from a rupture of the liver capsule. In other instances, the liver is yellow, greasy, and soft. There are generally abundant abdominal and intestinal (mesenteric) fat reserves present.

HISTOPATHOLOGY

Microscopic examination of liver tissue shows liver cells (hepatocytes) that are grossly distended with fat. There may be hemorrhages present. Fat within the hepatocytes are seen as clear spaces (vacuoles) within the cytoplasm of the hepatocytes[4,5,6]. The accumulation of fat within the liver weakens the integrity of blood vessels, leading to hemorrhage[7].

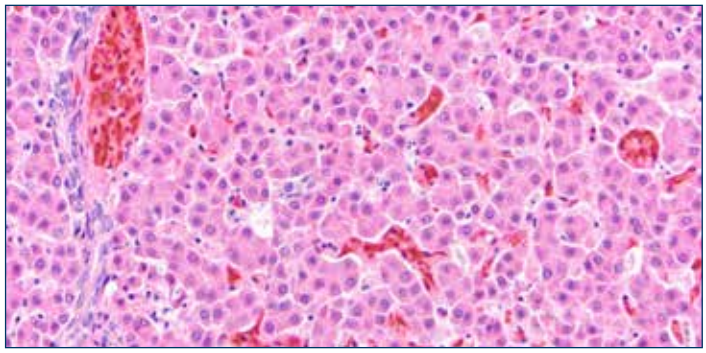

Figure 2a. Microscopic view of a normal liver. Image courtesy Dr. Yuko Sato.

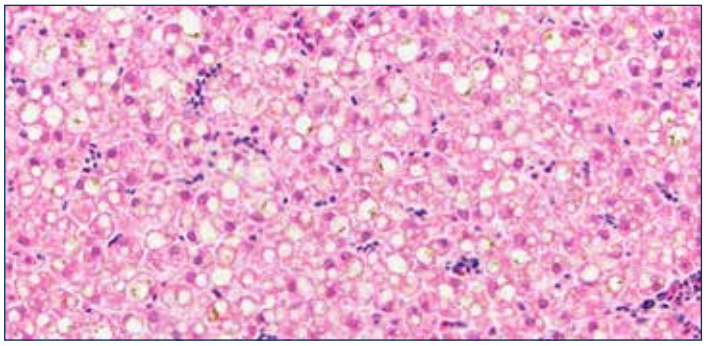

Figure 2b. Microscopic view of fatty liver hemorrhagic syndrome. Hepatocytes are distended with fat vacuoles. Image courtesy Dr. Yuko Sato.

EGG SHELL QUALITY

There is an association between FLHS and poor egg shell quality[8]. One important function of the liver is the activation of Vitamin D into its metabolically active form. Serum calcium levels in hens with FLHS are elevated, suggesting interference with the formation of active Vitamin D (1, 25 (OH_2) D_3) which is vital in the egg shell formation process[9].

POSSIBLE CAUSES OF FLHS

The exact cause of FLHS is unclear. Factors related to nutrition, genetics, environment, and hormonal influences have been proposed. It is suspected that a combination of these factors is needed to cause FLHS[2,10,11].

Body Weight and Energy Balance

Dietary energy consumed in excess of what is required is processed by the liver and stored as body fat. This occurs regardless of source of energy (i.e. fat vs. carbohydrate)[5]. When excess energy is available for fat synthesis by the liver over an extended period of time, obesity and increased fat infiltration of the liver occur[17].

FLHS was first recognized after high-energy density diets were introduced to the layer industry. These diets, especially those with a maize or wheat base, have been associated with higher-incidences of FLHS[12, 14, 15]. Layers housed in cages are less active than those in other housing systems; therefore, they have lower maintenance energy requirements, and are at a higher risk for receiving excess energy[7, 16].

Estrogen Predisposes the Flock to FLHS

The hormone estrogen is associated with sexual maturity and stimulates the liver to store more fat for egg yolk synthesis. When the bird comes into egg production, the liver size increases dramatically in response to estrogen levels. A combination of positive energy balance and influence of estrogen predisposes the laying bird to develop FLHS. This emphasizes the need to avoid excess energy intake, especially in the early laying period when birds are in a highly productive state.

Figure 4. An extreme case of fatty liver and obesity.

Heat Stress

The highest incidence of FLHS occurs during warm periods. Higher environmental temperatures reduce energy requirements, leading to a more positive energy balance[19, 20, 21]. Birds rely on evaporative cooling during respiration to regulate body temperature. Increased abdominal fat from excess energy can interfere with normal breathing and cooling, making these birds more prone to both heat stroke and liver rupture.

Mycotoxins

Mycotoxins, especially aflatoxins, which may contaminate cereals, induce liver lipid accumulation[22] and liver hemorrhages. The use of rapeseed meal in the diet increases the incidence of FLHS, because erucic acid or other toxic metabolites can affect the strength of the connective tissue in the liver,[23,24] leading to hepatic cell breakdown and hemorrhaging.

Figure 3. Massive liver hemorrhage and rupture of the liver capsule caused sudden death in this bird.

Figure 5. This bird died of liver hemorrhage. The blood clot is visible through the skin over the abdomen. Note the pale breast muscle devoid of blood.

PREVENTION STRATEGIES

Feed adequate energy to sustain the birds and optimize production, but not more. Maximizing energy intake in the early period of lay is essential to support productivity; however, energy requirements will decrease through lay as production decreases. It may be necessary to reduce diet density to avoid birds gaining excess weight. Limit energy intake through the use of a lower energy diet and/or changing feed management.

Replacing dietary carbohydrates with supplemental fat has been shown to reduce the incidence of FLHS as long as the energy level of the diet is not increased[13]. Supplemental fat depressess synthesis of new fatty acids, so the liver has to produce less fat for the yolk. This reduces the metabolic burden on the liver.

Use of crumbled or pelleted feed results in greater feed and energy intake than mash feed. Avoid crumb and pellets in flocks susceptible to FLHS.

Layer diets should contain adequate levels of Vitamin E (50-100l/kg) and selenium (0.3ppm) to ensure adequate levels of antioxidants to prevent tissue rancidity[26]. Supplementation with lipotropic agents such as choline (500mg/kg), methionine (0.1%), and Vitamin B12 help to mobilize fat from the liver, and support recovery in affected hens.

Calcium deficiency has been associated with FLHS. This can be addressed with the addition of large-particle calcium and Vitamin D to the ration. This allows the bird to eat more calcium without over-consuming the energy component of the feed.

Avoid any form of stress. Heat stress is a particular concern as it can precipitate or accentuate the occurence of FLHS[5].

One of the most important aspects of FLHS prevention is monitoring for risk factors and signs[10, 11]. Feed intake should be monitored, along with increases in body weights and mortality, and decreases in egg production. Routine (at least every 30 days) body weight and uniformity checks can help reveal development of excess body weight. Less uniform flocks are more likely to contain relatively heavier birds with a greater risk of FLHS. Perform post-mortem examinations of mortality to assess the condition of the liver, and be alert to excess abdominal fat.

Lipotropic Nutrients

Lipotropic nutrients are feed ingredients that promote healthy liver function and the export of fat from the liver. Methionine, choline, inositol, Vitamin B12, biotin, L-trytophan, carnitine, and selenium are essential for proper liver function and fat metabolism. Supplementation of these nutrients in the diet or in birds' drinking water has been used as a treatment for FLHS with variable success.

FOR MORE INFORMATION

For more on improving uniformity, see the "Growing Management of Commercial Pullets" Technical Update.

hyline.com/userdocs/pages/TU_PULLET_MGMT_ENG.pdf

For more on reproductive health, see the "Science of Egg Quality" Technical Update.

hyline.com/userdocs/pages/TU_EQ_ENG.pdf

For more on heat mitigation, see the "Understanding Heat Stress in Layers" Technical Update.

hyline.com/userdocs/pages/TU_HEAT_ENG.pdf

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