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RUPTURE OF THE GASTROCNEMIUS MUSCLE IN A COW TWO MONTHS AFTER TWIN BIRTH

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Abstract

The rupture of the gastrocnemius muscle was described in a cow who gave a twin birth. A tentative diagnosis of complete rupture of the muscle was based on information obtained from both anamnesis and clinical signs. The definitive diagnosis was made on necropsy. The role of serum minerals, especially Ca, changes in the muscle originated enzymes, and other laboratory parameters together with clinical examination findings was discussed.

Key words: cow, gastrocnemius muscle rupture.

Rupture of the gastrocnemius muscle is an injury with or without the Achilles tendon (10, 11, 17). It was observed in the cow, camel, horse, and humans (2, 3, 7, 13, 17). The earliest mention of the rupture of gastrocnemius muscle in the cow was in 1958 by Wheat and Asbury (17). Jumping or falling with legs extended under the body has been reported to be the frequent cause (2, 7). It can also occur after parturient paresis or dystocia when the cow struggles trying to rise (10, 17). In addition, severe straining during birth and fierce movement of the animals that were kept with no exercises for a long time has been reported to cause the injury (10).

Either the rupture may occur immediately after an injury, or the muscle or tendon may be weakened enough so that a mild strain may completely rupture it later. In cattle, the most common sites of muscle rupture are at the musculo-tendinous junction, and at the origin or insertion of the muscle (17).

The rupture of the gastrocnemius muscle may occur partially or completely (11). In the partial rupture, the signs are less pronounced, and the prognosis is better than that in the complete rupture (11, 17). Complete rupture of the muscle or its tendon produces marked changes (16, 17). The animal is unable to bear weight on the affected leg, and the tendon of the gastrocnemius remains relaxed during hock flexion. If the animal attempts to bear weight on the affected limb, the hock remains flexed, the point of the hock drops, and the plantar aspect of the metatarsus may contact to the ground. The hock rests nearly on the ground. The excessive flexion of the hock places tension on the digital flexor tendon, causing the digits to assume a flexed position (11, 16, 17). In addition, swelling and pain in the affected soft tissues can also occur (2, 7, 11, 13).

The mechanism of the gastrocnemius muscle rupture has been examined (7, 11, 13, 16, 17). Furthermore, etiologic factors effecting its development have also been given in the literature (2, 7, 10, 17). However, the role of calcium and phosphorus that are important in the locomotor disorders, and changes in the enzymes, which originate from muscles, as well as other laboratory parameters have not yet been studied with regard to the rupture of the gastrocnemius muscle in the cow. In this case report, the role of haematological and biochemical parameters, especially the concentration of minerals and muscle originated enzyme activity, together with clinical examination findings were for the first time discussed.

Material and Methods

A 5-year-old Holstein Friesian cow was brought to the Department of Internal Diseases at the University of Yüzüncü Yıl, with the complaint of a dropped hock (Fig. 1). The cow has given birth three times. The first two births were normal, with a single calf each time. However, at the last birth 2 months ago, the cow delivered twin calves. The animal was fed straw, bran, and barley according to its owner. According to anamnesis, while grazing on a sloped pastureland, the cow jumped from a water canal and rolled over. After that, the cow started to walk on both hind leg hocks. As a treatment, analgetic (Ronaljin®-Eczacıbaşı), calcium (Calcicure®-Provet), phosphorus (Fosfocure®-Provet), vitamin B_1 (Nervit®- Vetaş), and AD_3E vitamin

combinations (Ademin®-Cevadif) were given to the animal by a local veterinarian. Because no recovery was seen, the animal's owner brought the cow to our clinic 5 days after the problem occurred.

The animal was examined clinically. Bone fracture and luxation were not present. Blood samples were collected for laboratory analysis. Routine haematological parameters (packed cell volume, haemoglobin, mean corpuscular haemoglobin concentration, platelets, total and differential leukocyte counts), serum Ca, P, Mg, Fe, Na, K, and Cl concentrations, amylase, ALP, AST, ALT, GGT, LDH, and CK activities and other biochemical parameters (glucose, urea, creatinine, uric acid, total-conjugated and unconjugated bilirubin, total protein, albumin, globulin, and unbound Fe binding capacity) were determined. Furthermore, macroscopic and histopathological examinations were also performed after the animal's slaughter.

Results

In clinical examination, the body temperature (39.6°C), respiration rate (60/min), heartbeats (85/min) were higher than normal values. Swelling and crepitation on both gluteal regions were also observed. There was complete loss of hind leg function, which was characterised by the extreme over flexion of both hocks. The cow attempted to bear weight on the unaffected forelegs. Its hind limb hocks dropped to the ground; the digits then assumed a flexed position and the animal was trying to walk using its forelegs. The rupture of the gastrocnemius muscle should be suspected when clinical signs of walking were observed. In the present case, basing on information obtained both from anamnesis and clinical signs, a tentative diagnosis of complete rupture of the gastrocnemius muscle took place. Neither fracture nor luxation was observed in the affected hind legs.

The animal owner was informed that prognosis of the condition was poor because both hind legs were affected. Thus, the owner of the animal did not accept any treatment. Therefore, slaughter was suggested and the definitive diagnosis was made after slaughter. Post-mortem examination revealed complete rupture of both of the gastrocnemii muscles. The large swelling was the indicative of acute inflammatory response, which surrounded the injured muscles. Haematoma was also seen between the injured muscles but no degeneration in the gastrocnemii muscles was detected at the histopathological examinations.

Important laboratory findings and reference values are given in Table 1. Increases in CK, AST, LDH, ALT, globulin, and UIBC, and decreases in albumin, Ca, and Fe parameters were determined. In addition, Mg and total protein were at the lowest, and P was in the highest physiological reference values (8, 12). All haematological and other biochemical parameters were in the normal reference values (6, 8, 12).

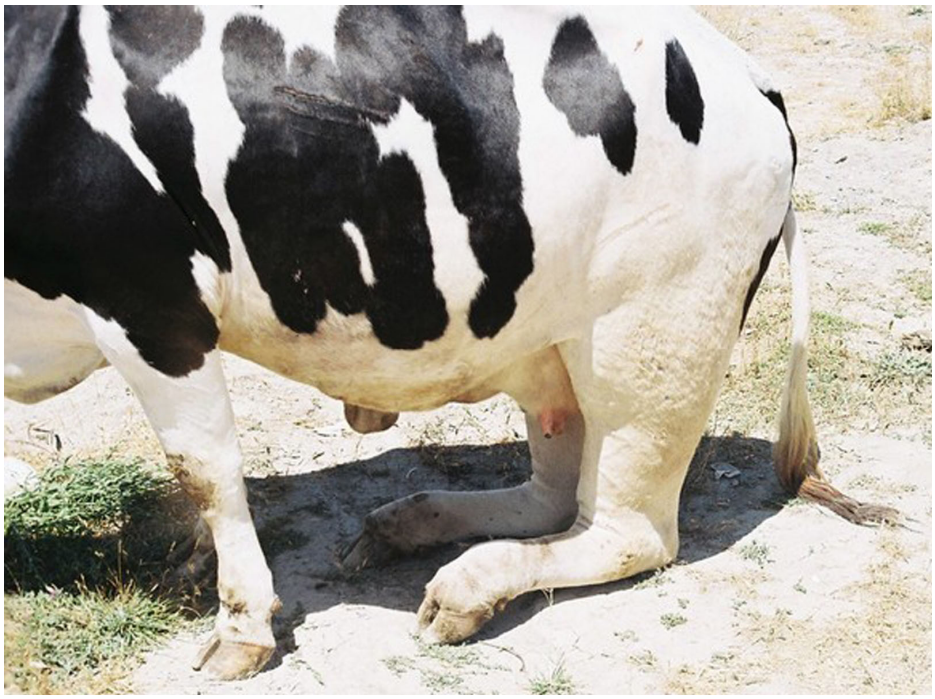

Fig. 1. Rupture of the gastrocnemius muscle with cow's hocks dropped to the ground.

Table 1
Reference values and important laboratory parameters in a cow with gastrocnemius muscle rupture

Parameter	Reference values[8,12]		Case values	Evaluation compared to reference values
	Range	Mean		
Total protein (g/dL)	6.7-7.4[8]	7.1±0.18	6.8	Low limit
Albumin (g/dL)	3.0-3.55[8]	3.3±0.13	1.0	Decrease
Globulin (g/dL)	3.0-3.48[8]	3.24±0.24	5.8	Increase
CK (IU/L)	44-228[12]	---------	1505	Increase
AST (IU/L)	78-132[8]	105±27	765	Increase
LDH (IU/L)	692-1445[8]	1061±222	1867	Increase
ALT (IU/L)	11-40[8]	27±14	162	Increase
Ca (mg/dL)	8.7-11.4 or 9.7-12.4[8]	11.08±0.67	8.0	Decrease
P (mg/dL)	5.6-6.5[8]	---------	6.3	High limit
Mg (mg/dL)	1.8-2.3[8]	2.05±0.25	1.82	Low limit
Fe (µg/dL)	57-162[8]	97±29	40	Decrease
UIBC (µg/dL)	63-186[8]	131±36	193	Increase

Discussion

In the aetiology of gastrocnemius muscle rupture, injury resulting from jumping and falling situations, causes a weakness of the muscles, and efforts to stand up during parturient paresis have been reported to play an important role (2, 7, 10, 16, 17). It was found that the severity of the rupture could be determined by the degree of relaxation of the tendon. In a complete rupture, the tendon is relaxed and the hock rests nearly on the ground (17). According to this information (7, 16, 17), a complete gastrocnemius muscle rupture in both hind limbs was diagnosed in the present study. Furthermore, the rupture was also confirmed macroscopically after the slaughter of the animal.

In clinical examination of the case regarding, body temperature (39.6°C), respiration rate (60/min), heartbeats (85/min) were all higher than the normal values. Furthermore, as a result of acute inflammatory response swelling, crepitation, and haematomas between the injured muscles on both gluteal regions were observed.

In this case, serum total protein level was at the lowest physiological reference limits, but the albumin level was quite low compared to reference values, whereas the globulin level was higher compared to physiological reference values (8). Kaneko *et al.* (8) reported that albumin is a negative acute phase protein and extensive inflammation accompanying any of the above-mentioned conditions may cause the hypoalbuminaemia. On the other hand, an increase in globulin content is a common finding in acute inflammatory diseases, and depends on an increase in acute phase proteins (8). Therefore, in this study, hypoproteinaemia with hypoalbuminaemia and hyperglobulinaemia developed possibly as a result of acute inflammatory condition between the injured muscles.

Serum Fe value was below 50 µg/dL, whereas serum UIBC was above references values (Table 1). It has been reported that serum Fe values decline in severe Fe deficiency, acute phase inflammatory reactions, and hypoproteinaemia. Furthermore, it has been suggested that fever and hypoproteinaemia occur due to acute-phase reactions (8). Therefore, a decrease in Fe and an increase in UIBC observed in the present study could be due to acute phase inflammatory reactions developed after gastrocnemius muscle rupture. Additionally, a decrease in serum Fe levels may also contribute to the occurrence of haematoma developed between the injured muscles. Determination of muscle-originated enzymes (CK, AST, LDH) in domestic animals has been reported to be practical and reliable parameters in the diagnosis of muscle damage (1, 4, 8, 9, 15). Among these enzymes, CK is especially well known to be specific for muscles and its concentrations in blood has been reported to increase, depending on the severity of the damage of the muscle cell membranes, (4, 8, 15). The other muscle damage indicators are AST and LDH. AST in all domestic species may be increased in skeletal muscle diseases, including trauma. To differentiate AST and LDH elevations as a result of liver disease from those due to muscle damage, it is possible to measure CK (1, 4, 8, 15). In muscle diseases, AST, LDH, and CK would be expected to increase (1, 4, 8, 9, 15). If the liver is affected concurrently to myopathy, ALT measurement may be useful (8), but severe muscle disease may also cause an increase in serum ALT activity (1, 4, 8, 15). Furthermore, Fry *et al.* (4) reported that CK, ALT, LDH, and AST combinations could safely be used in the diagnosis of nutritional myopathy. In the present study, CK, LDH, AST, and ALT values were found to be increased (Table 1). This situation was most probably the sign of gastrocnemius muscle injury. Similarly, Jesty *et al.* (7) reported an increase in CK values in foals with rupture of the gastrocnemius muscle. Furthermore, increased plasma activity in some tissue enzymes have also been described, including AST and CK, which is interpreted as a result of muscle cell membrane damage (15). Additionally, it is thought to be the result of hypocalcaemia and leads to the outward diffusion of

intracellular enzymes into tissue fluids and circulation (15).

Calcium and phosphorus are the minerals that play a central role in animals, including muscle contraction and neuronal excitability, and are essential structural components of the skeleton. In adult animals, there is a stable balance between Ca deposition associated with bone formation and Ca release associated with osteoclastic bone resorption (8, 15).

Parturient hypocalcaemia is a metabolic disease of high-producing dairy cows characterised by the development of severe hypocalcaemia, hypophosphataemia, and muscle paresis (8, 15). The pathogenic mechanisms responsible for the rapid and precipitous decrease in Ca and P levels in the blood are complex and involve several interrelated factors (5, 8). However, serum Mg may increase reciprocally as Ca declines, causing an increase in parathyroid hormone levels during hypocalcaemia (8, 14).

The cow discussed in the present study, received Ca treatment for 5 d before being presented to our clinic. Even though, Ca concentration was under the reference values (8). This situation shows that the animal was hypocalcaemic by that time. With regard to the fact that the cow delivered a pair of twins and was in the lactation period, Ca losses through milk should be quite high. Kaneko *et al.* (8) reported that the onset of lactation results in a sudden large demand on the Ca homeostasis. Furthermore, a cow producing 10 kg of colostrum will lose 23 g of Ca in a single milking (15). Calcium lost from the plasma pool must be replaced by increasing intestinal absorption and bone resorption of the element (8, 15). Similarly, it is reported that serum Ca levels are reduced to below 8 mg/dL in animals with parturient paresis. Furthermore, total serum Ca levels are reduced below normal in all cows at calving, whether they have milk fever or not (15).

In this case, serum P level was high compared to references values (8). In contrast, it has been reported that low serum P levels have been observed in clinical parturient paresis. A possible explanation is that the hypophosphataemia, which occurs with milk fever, is the result of the hypocalcaemia (8, 15). In this case, a high level of P could be due to the application of vitamins AD_3E and P preparation to the cow 5 d before. As a result, vitamin D elevated blood Ca and P levels progressively after 3 to 5 d (8).

Serum levels of Mg are usually moderately elevated (8, 14, 15), but in some areas low levels may be encountered, especially in cows on pasture (15). In this case, the Mg level was in the low references limits. There was the grazing season when the disease was diagnosed. For this reason, a decrease in Mg level may be due to seasonal hypomagnesaemia.

The importance of the Ca in maintaining muscle tone is well known. Additionally, skeletal, plain muscle atony, and general muscular weakness are the known physiological effects of hypocalcaemia. Stiffness of the hind legs is apparent, the animal is ataxic and falls easily, and on going down; the hind legs are stuck out stiffly. Furthermore, bone turnover, particularly resorption, is low in cows with parturient hypocalcaemia, and only a few osteoclasts are present on smooth, inactive trabecular bone surface (8, 15). In this case, the serum Ca level was lower than reference values (8). For this reason, the above symptoms were most probably present in our case. In addition to these symptoms, the cow tried to jump from a water canal, but muscle contractions did not allow it to be successful. Therefore, the animal fell down and the rupture occurred. Trauma was the most probably the primary cause of the problem, but secondary predisposing factors such as Ca, P, and metabolic profile of the animal played also an important role in the development of the disorder. Other biochemical parameters were changed after the occurrence of the problem.

A low level of Ca was most probably an important predisposing factor in the development of gastrocnemius muscle rupture. Due to the fact that the cow delivered twin calves and was in lactation period, Ca mobilisation was at the maximum level. Furthermore, insufficient and unbalanced feeding might also took part. Additionally, in the diagnosis of the rupture, serum minerals (Ca, P, Mg, and Fe), enzymes (CK, AST, LDH, and ALT), and other biochemical parameters (total protein, albumin and globulin) should as well be taken into consideration.

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