

< Case Report >

## Accidental electrocution in two cattle confined in stanchions

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### Abstract

On a farm with 6 Korean beef cattle, an adult cow and a calf suddenly died while eating. At that time, hair was pressed upon the stanchion facilities where the adult cow was fed. Two dead cattle were submitted to the Animal and Plant Quarantine Agency for disease diagnosis. Grossly, the mouth of the adult cow was full of feed that had been eaten before death, and there was a foamy fluid in the calf's trachea. Both hemorrhages were observed in the muscles, as well as in the internal organs such as the liver, lungs, and heart. Ruminal mucosa was easily peeled off. Histopathologically, both muscles and internal organs showed severe hemorrhages. In particular, affected muscles were shown segmental and band-like patterns of myonecrosis, disappeared some myocytes, burned hair follicles, and irregular surface of skin. Severe hemorrhages of muscles and internal organs were consistent with previous reports. Easily separated mucosa of rumen and muscle lesions were very characteristic. We determined electrocution according to the pathological findings, laboratory results, and traces of accidents. This report will help to understand of pathological lesions of electrocution. Furthermore, this case suggests that the electrical wires and devices must be installed and handled carefully during the construction of the cowsheds care.

**Key words :** Cattle, Electrocution, Stanchion, Histopathology

### INTRODUCTION

Electrocution is caused by high-voltage electric currents, and it causes sudden nervous shock with temporary faint or immediate death (Hussmann et al, 1995). Electrocution in cattle sometimes occur accidentally. Diagnosis of electrocution is performed synthetically based on circumstantial evidences, clinical signs, and pathological findings. The common circumstantial causes of electrocution are known as an incorrect electrical wiring in cowsheds, chewing electrical wires, and lightning strike. In addition, instantaneous death is characteristic, and the best indication of it is the presence of hay or other feed in the cattle's mouth called lock jaw. External findings of carcasses are from linear burns, jagged

line of singed hair, and the arboreal pattern visualized the dermal side of the skin by subcutaneous extravasations of blood. Microscopically, dermal collagen of the current mark appears hyalinized with Hematoxylin-eosin staining (H&E). Representative internal clinical signs are rumen distention, poor blood clotting, petechial, and ecchymosis in various organs (Schulze et al, 2016).

In previous cases, 220 voltages are known enough to kill adult cattle. Those cases were usually related to pumping pumps or milking machines in dairy cows (Ozmen and Haligur, 2007), however, the electrocution cases in cattle have been rarely reported. In Korea, there was one case of electrocution on a cattle farm where the floor of the barn was wet due to heavy rain and the electrical wire was installed along the steel roof and fence (Bae et al, 2008). However, the pathological find-

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ings of the previous study were limited to hemorrhages and congestions of the internal organs. In the present study, we reported various pathological findings and figures of an electrocution case from cattle farm to pathologically understand of the disease.

## CASE

On a farm with 6 Korean beef cattle, two of them (an adult cow and a calf) suddenly died while eating on July 17, 2019. Two dead cattle were submitted to the Animal and Plant Quarantine Agency (APQA; Gimcheon, Republic of Korea) for disease diagnosis. Two cattle were analyzed through history-taking, necropsy, and histopathological examination.

Gross lesions were observed through necropsy, various organs and tissues including brains, lungs, hearts, spleens, livers, kidneys, stomachs, intestines, tracheas, and muscles were obtained for differential diagnosis. Collected samples were fixed in 10% neutral buffered formalin for 24 hrs and routinely processed. Prepared 2 µm thick of sections were taken from paraffin-embedded tissues, stained with hematoxylin-eosin (H&E), and analyzed using light microscopy (Lee et al, 2018).

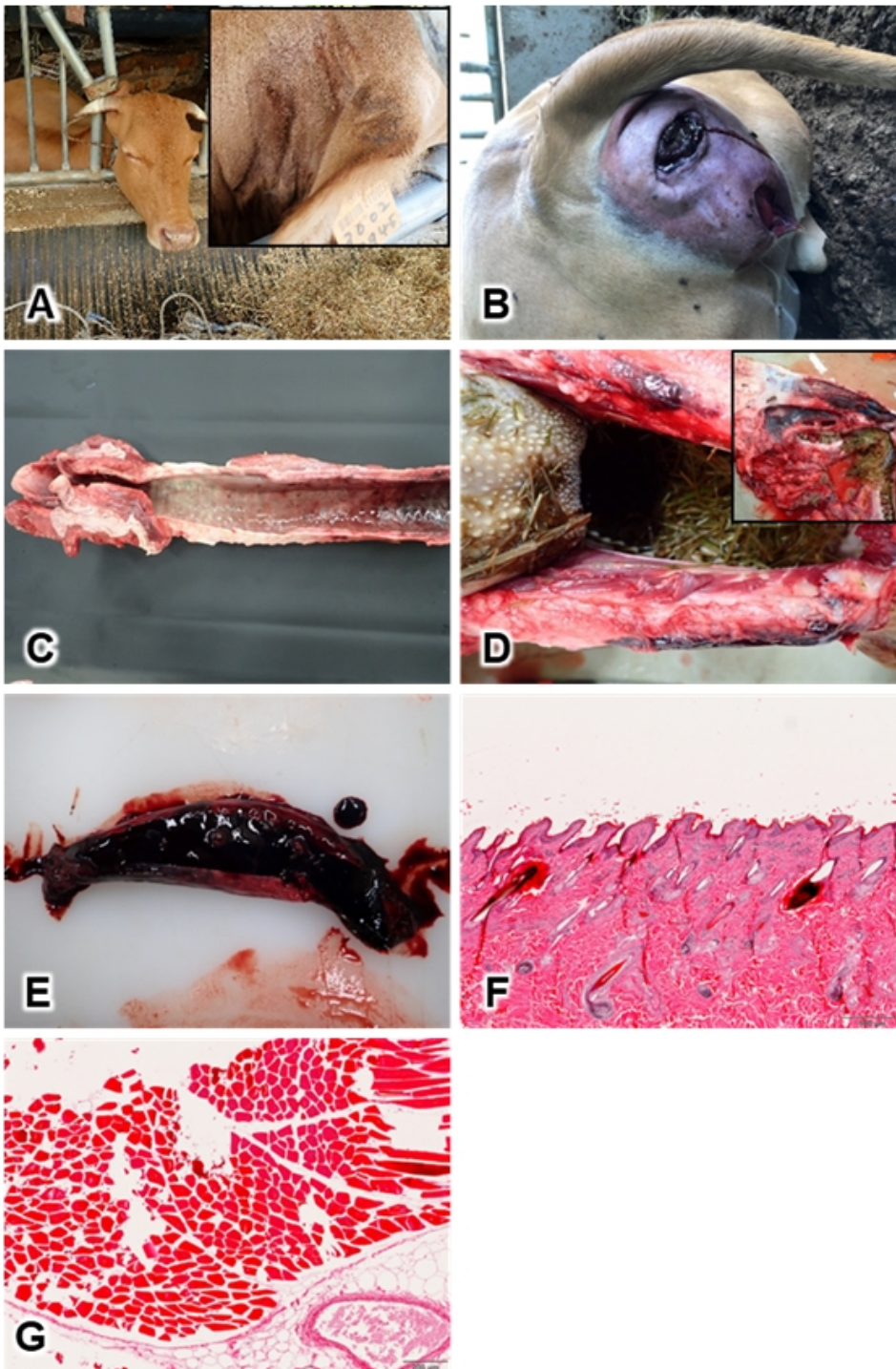
### Case 1 (An adult cow)

Grossly, hair was pressed upon the stanchion facilities where the adult cow was fed, and jagged lines of singed hair on the right necks were shown (Fig. 1A). Protruded reddening anus with bloody contents were observed (Fig. 1B). Severe reddening, petechia, and ecchymosis were systemically shown, in particular, muscular hemorrhage and overall reddening of those were observed after skinning. Remarkably, a lot of petechia and ecchymosis were shown in abdominal muscles, and dark blood in submandibular muscles were also observed. The oral cavity of the adult cow was full of hays that had been eaten before death (Fig. 1D). The epiglottis was rubescent, a lot of petechias in upper tracheal mucosa, and dark bleeding infiltration in mucosa of lower trachea and nasal turbinate were observed in an adult cow (Fig. 1C). Lungs were also reddened, and con-

gestions were shown in cut surface of them. Petechia and ecchymosis were observed at the epicardium of hearts and atrial auricle with poor blood clotting in both sides of ventricles. The spleen was enlarged with bloody contents on the surface, and dark poor-clotted blood was leaked out of the cut surface (Fig. 1E). The liver was changed grayish, and kidney had congested and pale lobes. Detachment and reddening of ruminal mucosa were shown. Enlargement of intestines was observed, in addition, reddish serosa and enlargement of intestinal vessels were also shown. Histopathologically, both muscles and internal organs showed severe hemorrhages. In particular, affected muscles showed hemorrhagic segmental and band-like patterns of myonecrosis, disappeared some myocytes, burned hair follicles, and irregular surface of skin (Fig. 1F, 1G). In addition, severe hemorrhage was observed in heart, spleen, liver. No causative agents such as bacteria, virus and parasite were identified in other laboratory tests (data not shown).

### Case 2 (A calf)

Grossly, a huge amount of foamy drooling was shown out of the noses of the calf (Fig. 2A), and protruded reddening anus with bloody contents were also observed. In addition, 10 cm of jagged line was observed on singed hair on the neck. Severe reddening, petechia, and ecchymosis were systemically shown, in particular, muscular hemorrhage including abdominal and femoral hemorrhage, and overall reddening of those were observed. In addition, foamy change around neck muscle and a number of ecchymosis in a calf were observed. Similar to an adult cow, the esophagus of the calf was also stuck by feed (Fig. 2B). Redness and congestion of lung, and hemorrhage of epicardium and dark reddish line of atrial auricle were observed in thoracic organs (Fig. 2C). In addition, poorly coagulated blood was shown in ventricles. Irregular large spots were observed on the hepatic surface, in addition, hemorrhage and congestion were shown on the hepatic cut surface (Fig. 2D). Pale spots were also observed on the renal cut surface. The ruminal mucosa was easily peeled off (Fig. 2E), and severe redness was detected in abomasum



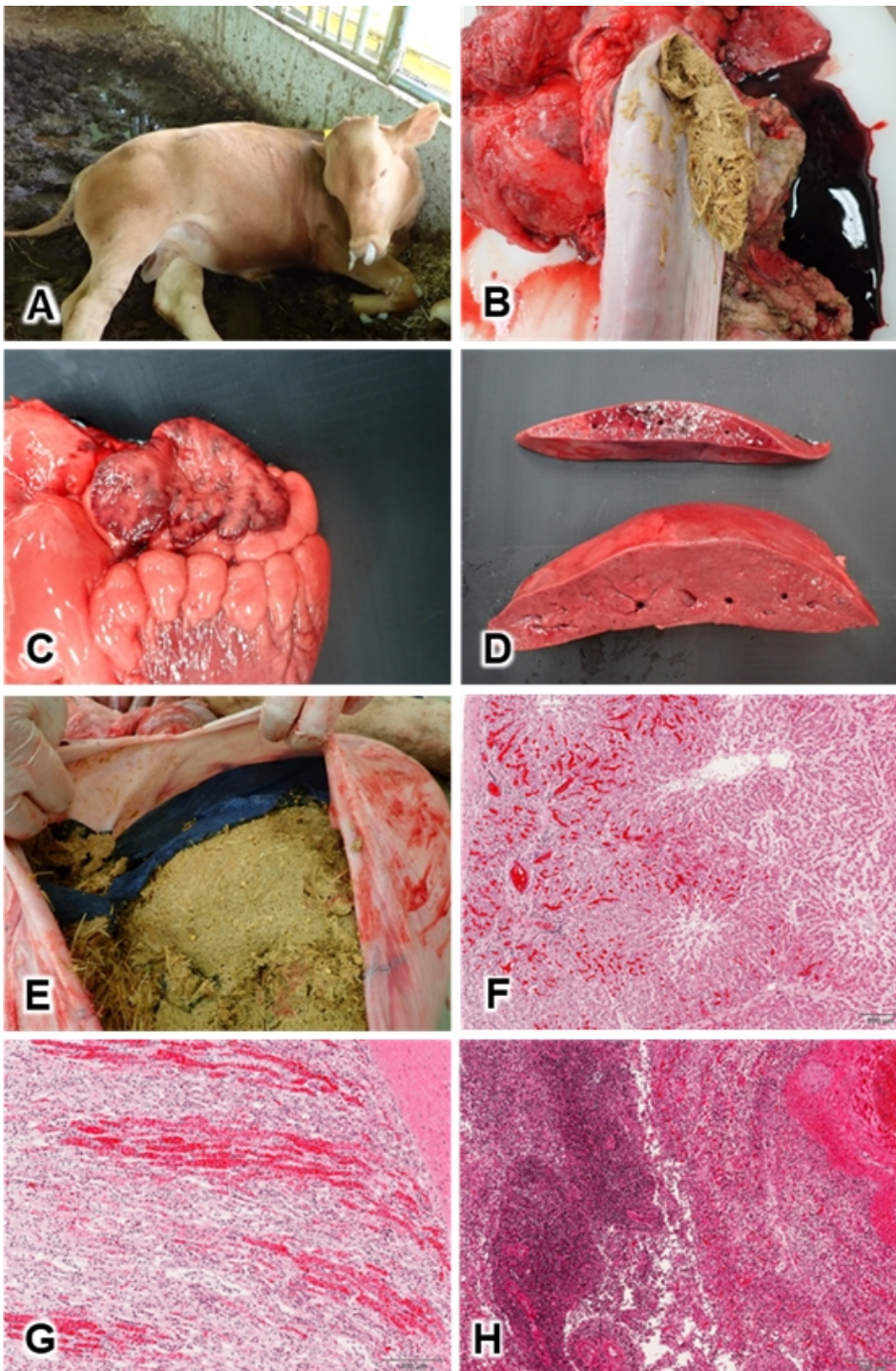
**Fig. 1.** Pathological findings of an adult cow. (A) A dead adult cow confined in stanchion. Insert shows Singe mark on the right neck. (B) Protruded reddened anus and bloody contents. (C) Petechia and ecchymosis at the trachea mucosa and epiglottis. (D) Hays in the oral cavity. Insert indicates cut surface of the head with hemorrhage in the mucosa of nasal concha and cavity. (E) Poor blood clotting and severe reddening in the spleen. (F) Irregular eliminations of epidermis, hemorrhage of dermis, and black-colored hair follicle in the skin. H&E stain. Bar=500  $\mu$ m. (G) Segmental and band-like patterns of myonecrosis in the right neck muscle. H&E stain. Bar=200  $\mu$ m.

mucosa. Small and large intestines were enlarged, their vessels were severely congested on the multiple serosa, and intestinal contents were pinkish and watery. In addition, severe hemorrhages were observed histopathologically in liver, kidney, spleen (Fig. 2F~2H). No causative agents such as bacteria, virus and parasite were

identified in other laboratory tests (data not shown).

The summaries of gross and histopathological findings for two cattle comparing with reference cases were shown in Table 1 (Ozmen and Haligur, 2007; Bae et al, 2008; Gal et al, 2016).





**Fig. 2.** Pathological findings of a calf. (A) A dead calf showing a huge amount of foamy drooling out of the nose. (B) Stuck contents in the esophagus. (C) Petechia and ecchymosis on the atrial auricle. (D) Cut surface of reddened liver. (E) Easily peeled ruminal mucosa. (F) Hemorrhage in the liver. H&E stain. Bar=200 µm. (G) Hemorrhage in the kidney. H&E stain. bar=200 µm. (H) Hemorrhage in the spleen. H&E stain. bar=200 µm.

## DISCUSSION

Because a few electrocution cases in cattle were reported, the history, clinical signs, and histopathological findings in this case are significant for veterinary diagnosis. Electrocuted cattle in this case showed the

typical clinical signs such as sudden death, jagged line of singed hair, lock jaw, poor blood clotting, and hemorrhage in various organs, which were described in previous cattle cases (Ozmen and Haligur, 2007; Bae et al, 2008).

The circumstances and external appearances were

**Table 1.** Gross and histopathological findings in two cattle and reference cases

Gross pathological findings	Cases				
	1	2	3	4*	5
<b>Gross findings</b>					
Jagged line of singed hair on affected site	○	○			
Protruded reddening anus	○	○			
A huge amount of foamy drooling in nose		○			○
Overall muscular reddening	○	○			○
Abdominal muscular petechia and ecchymosis	○	○			○
Femoral muscular hemorrhage		○			○
Feed in the oral cavity and esophagus	○	○			○
Rubescence epiglottis	○				○
Petechias in tracheal mucosa	○				○
Overall pulmonary reddening and congestion	○	○	○		○
Petechia and ecchymosis on the epicardium	○	○	○	○	○
Poor blood clotting in ventricles	○	○		○	○
Dark poor-clotted blood in spleen	○				○
Grayish pink liver	○	○	○		
Congested and pale lobes of kidneys	○	○	○		○
Detachment and reddening of ruminal mucosa	○	○	○		
Enlargement of small and large intestines	○	○			
Reddish serosa and enlargement of intestinal vessels	○	○	○		
Pinkish watery contents in large intestines	○	○			
<b>Histopathological findings</b>					
Severe hemorrhage in the affected muscles	○	○		○	○
Infiltration of inflammatory cells in muscles		○		○	
Segmental and band-like patterns of myonecrosis	○			○	
Disappearance of some myocytes	○				
Burned hair follicles and irregular surface of skin	○				
Severe diffuse pulmonary congestion and edema			○		
Severe hemorrhage in the lung and respiratory tract					○
Severe hemorrhage in the heart	○	○	○	○	○
Severe hemorrhage in the spleen	○	○	○		
Severe hemorrhage in the liver	○	○	○		
Severe hemorrhage in the kidney		○	○		○
Congestion or hemorrhage in the mucosa of rumen			○		
Congestion or hemorrhage in small intestine			○		

\*A case contained the data involved in heart, not for whole body.

1, case 1 (an adult cow); 2, case 2 (a calf); 3, electrocution case of cattle in Bae et al, 2008; 4, electrocution case of cattle in Ozmen and Haligur, 2007; 5, electrocution case of horse in Gal et al, 2016; ○, detection in each case.

clues to diagnose the electrocution. An adult cow was dead with confined neck upon the stanchion facility, and a calf was also dead beside the same stanchion in the barn. The uneaten hays were filled in the fed boxes beside the stanchion. The typical pathological findings of sudden deaths by passage of electricity were jagged line of singed hair on the confined neck, huge amount of foamy drooling at the nose, discharge of bloody intestinal contents. In previous case for electrocution in Korean native cattle, specific circumstantial causes such

as heavy rain and fallen electric wire induced the electrocution (Bae et al, 2008). On the other hand, no factors were observed around the cowshed except for shutting out of switch in the residual-current circuit breaker beside of the barn in this case. To judge from it, we assumed that overcurrent temporarily released to stanchion in the cowshed.

In addition to history-taking, necropsy was performed for definite diagnosis based on observation of clear gross lesions. The poorly masticated hays in the oral

cavity and esophagus of two cattle suggested the sudden death during eating, and severe hemorrhage was observed in the neck muscle which was attached to the stanchion. Furthermore, considering the severe hemorrhage in the nasal turbinate, tracheal mucosa and lung, respiratory damage was assumed, which was reported in previous study (Gal et al, 2016). In addition, cardiac damage was also considered to one of the major causes of death through the observation of reddening in entire heart, and petechia in the epicardium and atrial auricle. These signs were also reported in previous clinical cases (Ozmen and Haligur, 2007; Bae et al, 2008). Apart from respiratory and cardiac lesions, congestion, hemorrhage, and poor blood clotting were shown in the all over the bodies including muscles and various internal organs, and these signs were identical with those of fulminant death in the previous cases (Anon, 2005; Radostits et al, 2007; Munro and Munro, 2008). Various histopathological findings such as hemorrhages in internal organs, segmental patterns of myonecrosis with hemorrhage, disappeared some myocytes, burned hair follicles, and irregular surface of skin supported the gross findings, furthermore, those were representative findings in previous electrocution reports (Kagan, 2016; Schulze et al, 2016). Considering all the history and pathological features, we concluded that the sudden deaths of two Korean native cattle were caused by systemic severe shock by accidental electrocution.

The 220 voltages which are standard voltage in Korea are sufficient to kill adult cattle (Ozmen and Haligur, 2007). Our results also revealed cattle are very vulnerable to electric shock resulting from electrification in stanchion. Although the number of the dead cattle in this study is limited, this report provides a lot of valuable pathological findings for understanding of electrocution. Furthermore, this case suggests that the electrical wires and devices must be carefully installed and handled during the construction of the farms, thoroughly be checked in rainy or humid days.

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## CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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