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Presumptive Border Collie collapse in a dog: serial clinical observation and successful management

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Abstract

A 6-month-old female Border Collie presented with a history of collapse after strenuous exercise. The dog was normal between episodes but experienced loss of focus and ataxia after exercise. This is particularly noticeable under hot weather conditions. No remarkable findings were observed in the diagnostic tests. Based on these results, the patient was tentatively diagnosed with Border Collie collapse (BCC). After exercise restriction, the dog had no episode of collapse and remained clinically well with no signs until the follow-up period of 8 months was complete. To our knowledge, this is the first case report of BCC in South Korea.

Keywords: ataxia; Border Collie collapse; dogs; episodic collapse; exercise-induced collapse

Border Collie collapse (BCC) is an episodic nervous system disorder triggered by strenuous exercise in Border Collies and related breeds [1]. BCC-affected dogs are normal at rest and with mild exercise but occasionally show abnormal gait following prolonged excessive exercise [2]. The most common factors associated with an episode in affected dogs are high temperature and excessive activity, including repetitive plays such as retrieval of balls or toys and herding stock [2].

It is common for symmetrical ataxia to affect all four limbs; the hindlimbs are more affected than the forelimbs [1,2]. Collapse episodes include abnormal mentation or loss of focus, disorientation, ataxia such as crossing the legs, falling to the side, increased hindlimb extensor muscle tone, delayed protraction stage, and dragging limbs [1]. In severe cases, dogs can show a collapse episode with an inability to ambulate [2]. However, gait and mentation can return to normal, typically within 30 min of rest [1].

There is no specific test for BCC; however, a presumptive diagnosis can be achieved by excluding other diseases associated with collapse and exercise intolerance, such as hypoglycemia, cardiac arrhythmias, severe anemia, severe pulmonary disease, myopathies, and other neurological disorders such as dynamin 1-associated exercise-induced collapse (dEIC) [3-9].

Clinical or laboratory evaluation results of BCC-affected dogs do not show any abnormalities, and no dog has been reported to exhibit systemic signs or abnormal behavior just before an episode [2,3]. BCC-affected dogs can live normally if they limit trigger activities, especially in hot weather [10]. According to the survey results of a study, there were no deaths during the collapse [2].

To our knowledge, BCC has never been reported in South Korea, but it may be underdiagnosed. This case is the first report of BCC in South Korea and would inspire veterinarians to consider the possibility of BCC in the case of collapse in young Border Collie and inform the management and prognosis of BCC dogs.

A 6-month-old female Border Collie presented with a 1-month history of four collapses during or immediately after strenuous exercise. The dog was normal between episodes but developed hindlimb weakness and fell to the side after about 1 hour of strenuous exercises, such as repetitive plays like retrieval of frisbees and agility training (Fig. 1). At that time, the dog also experienced loss of focus, disorientation, and crossing of the legs, which were particularly noticeable under hot weather conditions. These episodes did not progress over time, and the owner did not report any severe respiratory, gastrointestinal, or neurologic signs.

General physical examination results, pre-exercise gait, and patellar reflexes were normal. Laboratory test results, including complete blood count, electrolyte concentration, serum biochemistry, and gas analysis, was essentially normal. A normal electrocardiogram (ECG), normal thoracic radiographs and normal echocardiography showed that cardiac causes were unlikely, and no remarkable findings were detected on magnetic resonance imaging (MRI) (Figs. 2, 3).

The gross appearance of cerebrospinal fluid (CSF) obtained by cisternal puncture was clear and colorless, and the results of the CSF analysis, including total protein (< 0.10 g/L; reference interval [RI] < 0.25–0.30) and total nucleated cell count (0 cell/μL; RI < 5), were within the normal reference ranges. CSF cytology showed only a small number of lymphocytes and monocytes. Based on these results, the patient was tentatively diagnosed with BCC.

Initially, we limited the dog's activity duration according to its state and the weather conditions. We also recommended that a cooling scarf is worn on the dog, especially in hot weather, and that exercise is done in the evenings rather than during the day.

The patient afterward showed no episodes of collapse. Furthermore, with a decrease in environmental temperature, the dog no longer had the same symptoms, despite engaging in similar exercises as before. Consequently, after starting the management, the patient had no episodes of collapses and remained clinically well with no signs until the follow-up period of 8 months was complete.

In Border Collies and related breeds, an episodic nervous system disorder triggered by strenuous exercise is called BCC [1]. Although the reported incidence of BCC is low, it is necessary to consider the possibility of BCC in Border Collies with collapses. Furthermore, BCC has no specific test, a presumptive diagnosis can be achieved by excluding other diseases associated with collapse and exercise intolerance [2,3,11].

A retrospective study suggested that the age of onset ranged from 4 months to 7 years (median, 2 years), but there was no sex predilection [2]. The most common causative factors associated with BCC are high temperature and excessive activity, including agility or repetitive retrieval of a ball or toy [2]. Typical-

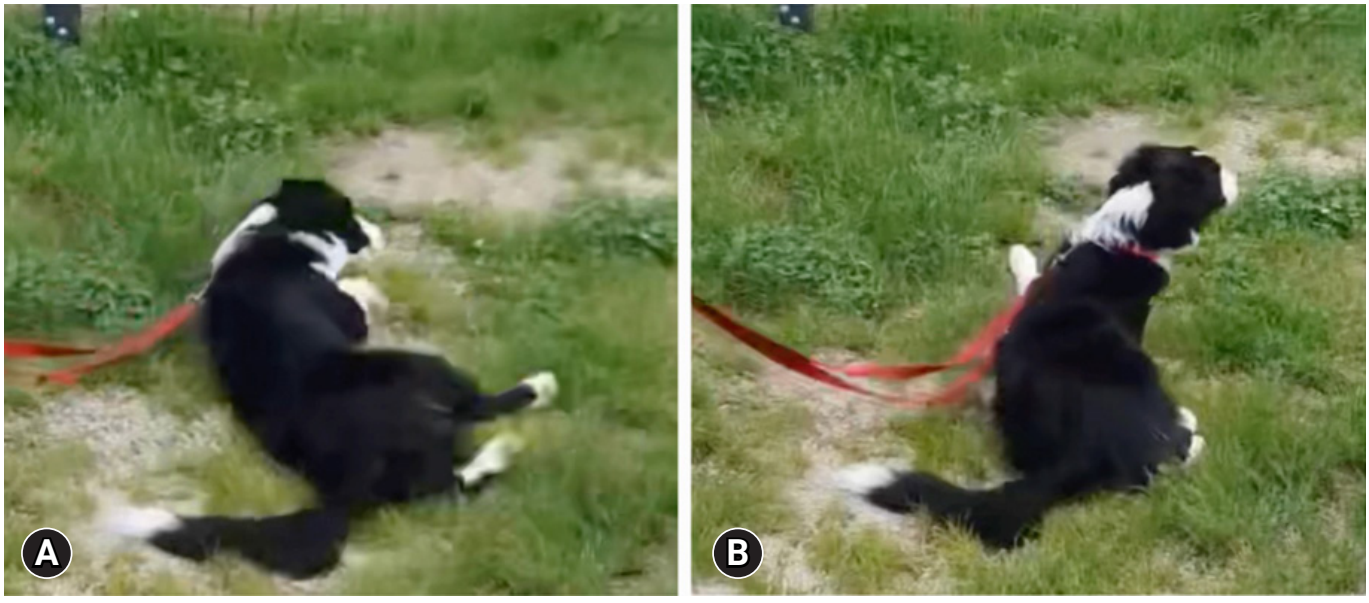

Fig. 1. Captured images on videotape. The patient is staggering, falling to the side (A) and inability to ambulate for a moment (B).

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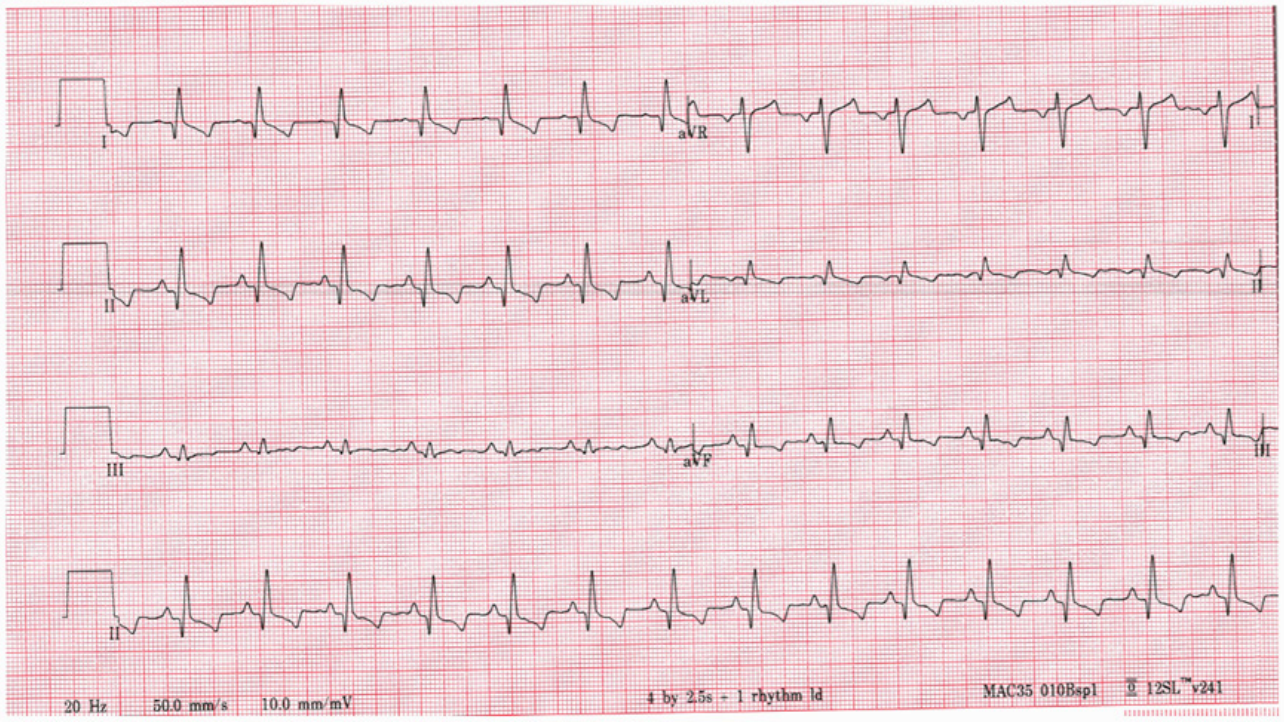

Fig. 2. Three-lead electrocardiogram recording was obtained from the dog in right lateral recumbency. At this time, the patient had a normal sinus rhythm with a mean heart rate of 170 beats/min (paper speed = 50 mm/s; 10 mm = 1mV).

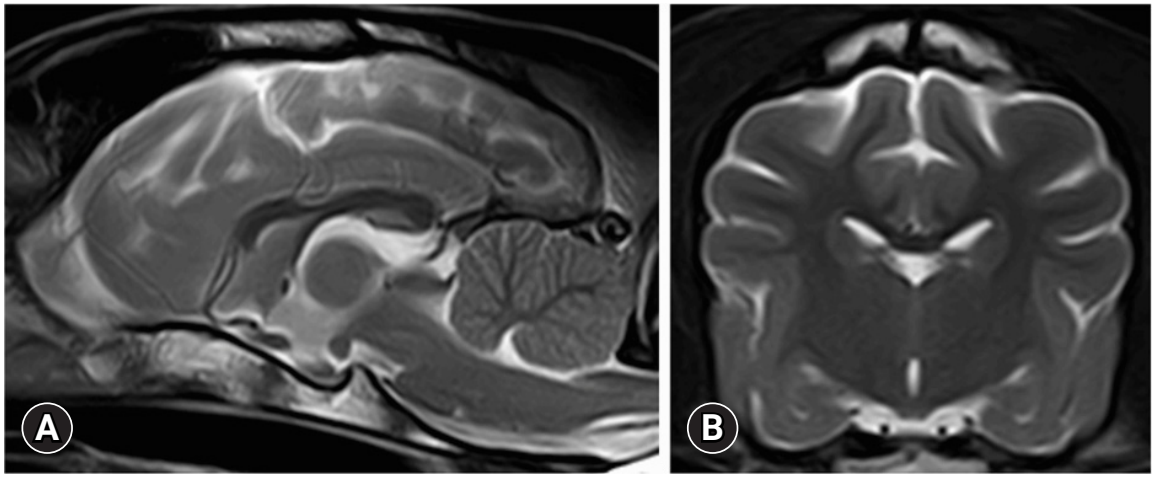

Fig. 3. Postcontrast magnetic resonance imaging (MRI) images of the brain at diagnosis. T2-weighted sagittal MRI image (A) and T2-weighted transverse MRI image (B) have no remarkable findings.

ly, affected dogs experience an episode after 5 to 15 minutes of strenuous exercise [3]. BCC-affected dogs are normal at rest and with mild exercise but occasionally show abnormal gait following prolonged excessive exercise [2]. In severe cases, dogs can show a collapse episode with an inability to ambulate [2].

In a retrospective study, symmetrical ataxia of all four limbs, especially the hindlimbs, was observed in all BCC dogs, and increased hindlimb extensor tone was commonly observed [2]. Affected dogs often cross limbs when walking in a circle and fall to a side [2,3]. It is also common for mentation to be altered during an episode. At the onset of an episode, some dogs suddenly lose focus or interest in the work being performed [2,3]. Gait and mentation return to normal within 30 minutes of rest [1].

In this case, the first collapse episode occurred at 4 months of age. The patient was normal at rest but showed an episode following strenuous exercise for approximately 1 hour. During the

collapse episode, the patient showed ataxia of all four limbs, altered mentation such as loss of focus, crossed limbs when walking in a circle, staggering, and finally falling to a side. Gait and mentation both returned to normal within approximately 10 minutes of rest. These symptoms were fairly consistent with collapse episodes associated with BCC. Therefore, a presumptive diagnosis of BCC was made in this patient.

BCC is thought to be an episodic disorder of the central nervous system. In BCC, the genetic basis is yet to be revealed; however, a study suggests that BCC is a heritable disease where genetic variants are risk factors for the disorder [1]. BCC is also estimated to be a heat-related disease [3]. This disorder differs from heat stroke, a severe illness characterized by core body temperatures > 41°C with central nervous system dysfunction [12]. Following strenuous exercise, body temperature is highly elevated in affected dogs, but not different with healthy dogs participating in the same exercise [3].

Affected dogs recover quickly from collapse episodes without further intervention and without important clinical or laboratory result, unlikely diagnosing with heat stroke [3,13,14]. Although the body temperature after exercise is not different from that in normal dogs, hot weather conditions have been considered a trigger for collapse in affected dogs [3]. Therefore, affected dogs must avoid prolonged strenuous exercise at high environmental temperatures, and owners should take action to cool the dogs during collapse episodes [3]. BCC-affected dogs can live normally if trigger activities are limited especially in hot weather [10].

In this case, the patient recovered quickly (within 10 minutes) from the collapse episodes and had normal mentation and gait after recovery. The dog showed no laboratory abnormalities and did not require further intervention. These results suggest that this patient had BCC, unlikely to be diagnosed as heat stroke.

BCC is clinically similar to dEIC, a hereditary episodic neurologic disease [2]. Both BCC and dEIC cause collapse following exercise and tend to occur during exercise in hot weather [3,15]. However, BCC and dEIC have a different etiology and some obvious clinical differences. A dynamin1 (DNM1)-gene-mutation is not detected in the dogs with BCC, which is detected in the dogs with dEIC [7,8]. BCC-affected dogs have altered mentation, whereas dEIC-affected dogs have alert mentation during collapse [6]. While dEIC-affected dogs typically attempt to continue moving by dragging their hindlimbs, BCC- affected dogs tend to display ataxia in all four limbs with scuffing or knuckling during walking, staggering, and then falling [6].

In the present case, although diagnostic testing of DNM1 was not possible due to shipping and quarantine problems, the patient was considered to have BCC due to the patient's obvious history of collapse, including altered mentation, ataxia with all four limbs, and falling on the side. However, additional genetic testing of DNM1 is recommended for obvious differential diagnosis, and further studies are needed to determine the significant differences between BCC and dEIC.

In this study, there is a limitation that a muscle biopsy was not performed. In the previous study, the dog with BCC showed normal clinical examination during rest and normal creatine kinase (CK) measurement [3]. In the same study, some dogs with BCC had taken the muscle biopsy, and all abnormalities of muscle biopsy results were considered minimal and unlikely that their exercise intolerance is related [3]. In the present case, the dog has normal clinical examination during rest, normal CK measurement, and the absence of muscular changes on physical examination and MRI. Furthermore, this patient showed no episodes of collapse after exercise management. Unfortunately, although a muscle biopsy could not be performed because of the owner's refusal, it was determined that the possibility of BCC was very high.

This case describes the first clinical report of BCC in South Korea. BCC is an episodic nervous system disorder triggered by prolonged strenuous exercise, and its incidence is rare. However, BCC is likely to be overlooked or underdiagnosed, although the prognosis is good with appropriate exercise restrictions. Thus, clinicians must consider the possibility of BCC in cases of collapse in young Border Collie patients.

Written informed consents have been obtained from all owners that donated their animals for the study, and actual cats remained anonymous.

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