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Noise Phobia-Induced Relative Polycythemia in a Dog

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Abstract : A 6-year-old castrated male Miniature Pinscher dog was referred due to shaking, panting and inappropriate elimination during thunderstorms. The dog had noise phobia after a car accident two years ago. The intensity of the fear of noise, especially with thunderstorms, worsened during the past 3 months (thunderstorm season). Physical examination revealed hyperthermia, tachypnea (panting), mild tachycardia, and an elevated systolic blood pressure. Laboratory examination revealed mild polycythemia with a lower oxygen pressure and saturation. Based on the history, physical examination, and laboratory tests, the dog was diagnosed as a noise phobia concurrent with relative polycythemia. Treatment was initiated with behavior modification with desensitization, counter-conditioning, and medication. Music therapy was also used and appeared to be beneficial. Clinical signs including polycythemia are improved. This case indicates that relative polycythemia can be occurred by chronic mental stress, such as noise phobia in a dog.

Key words **:** clomipramine, chronic mental stress, dog, music therapy, noise phobia, polycythemia.

Introduction

Noise phobia is a commonly reported behavioral problem in dogs, especially with loud noises such as thunder, fireworks and gunshots (20,21). Different from other noise phobias, thunderstorm phobia is related not only to sound but also lightning, barometric pressure and even smells (11,21). The pathophysiology of the fear and phobia has not been fully established. However genetic predisposition, restricted socialization, unpleasant events and negative reinforcement are possible causes (11,20,21). Various clinical signs exhibited during fear stimuli such as: panting, pacing, trembling or shaking, dilated pupils, vocalization, hiding and aggression have been observed (5,11,14,20,21). Treatment usually focuses on behavior modification, such as desensitization and counter-conditioning, and medications that influence serotonin metabolism (5,15,19).

To our knowledge, this case is the first published report of reversible polycythemia with noise phobia, caused by traumatic event.

Case

A 6-year-old castrated male Miniature Pinscher dog weighing 3.1 kg was referred for trembling, hiding and anxiety during thunderstorms. The dog developed fear of noise after a car accident two years ago and the intensity of the noise associated fear, especially during thunderstorms, increased over time. After the car accident, the dog exhibited trembling and panting with a loud noise and reluctant to get in the car over the two years. The symptoms got worsen and inappropriate urination, trembling, panting, owner seeking and hiding was shown during thunderstorms and the dog was afraid of to go out especially raining days. The clinical signs worsened during the last three months (thunderstorm season) and induced severe shaking, panting and inappropriate elimination outside house even after the storms had passed. On admission, the dog was restless, panting and trembling. Physical examination revealed hyperthermia (39.7°C), tachypnea (panting), mild tachycardia (156 beats per minute), and elevated systolic blood pressure (165 mmHg, Cardell Model 9401, Sharn Veterinary Inc.). The capillary refill time and skin turgor were normal. There was no dehydration. The hemogram showed an elevated red blood cell (RBC) count (8.82×10^6/μl; reference range, 5.5-8.5 $\times 10^6$/μl) and hemoglobin (Hb) concentration (22.1 gm/dl; reference range, 12-18 gm/dl) with mild polycythemia (Hematocrit 59.07%; reference range, 37-55%) (Table 1). The serum chemistry showed mild hyperglycemia (139 mg/dl; reference range, 10-118 mg/dl). Urinalysis was unremarkable except for aciduria (PH 6.0). Further examinations were performed to determine the cause of the polycythemia. No abnormalities were observed on the plain radiographs and abdominal ultrasound. Results of arterial blood gas analysis revealed low oxygen pressure (PaO_2, 58 mmHg; reference range, 80-110 mmHg) and oxygen saturation (91%; reference range, over 95%).

Based on history, signs were definitely compatible with noise phobia and the car accident was assumed possible pre-

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Table 1. Hematological, biochemical data and treatment options in a dog with polycythemia

	Day 0[a]	Day 7	Day 24[b]	Day 35	Day 70[c]	Reference
WBC ($\times 10^3/\mu l$)	6.46	7.77	7.41	6.91	9.35	6-17
RBC ($\times 10^6/\mu l$)	8.82	8.78	8.94	8.37	7.94	5.5-8.5
Hb (gm/dl)	22.1	21	21.2	20.2	18.4	12-18
PCV (%)	59.07	58.11	58.47	51.52	48.97	37-55
PLT ($\times 10^3/\mu l$)	322	309	421	338	464	200-500
BUN (mg/dl)	22.4	ND	24.8	27.2	19.8	8-26
CRSC (mg/dl)	1.2	ND	1.1	0.9	1.1	0.5-1.3
TP (g/dl)	7.1	ND	7.2	6.9	7.1	5.4-7.4
ALB (g/dl)	4.1	ND	3.5	3.9	3.9	2.9-4.2
Glu (mg/dl)	139	ND	127	107	113	70-118

ND: Not done.
WBC; white blood cell, RBC; red blood cell, Hb; hemoglobin, PCV; packed cell volume, PLT; platelet, BUN; blood urea nitrogen, CRSC; creatinine, TP; total protein, ALB; albumin, GLU; glucose.
[a]Desensitization, Counter-conditioning and Clomipramine (2 mg/kg, twice daily, PO)
[b]Desensitization, Counter-conditioning, Clomipramine (3 mg/kg, twice daily, PO), and Music therapy
[c]Desensitization, Counter-conditioning, Clomipramine (2.25 mg/kg twice daily, PO), and Music therapy; Two months after the initial treatment, clomipramine dose was gradually decreased and withdrawal at two weeks intervals while behavior modification including music therapy continued.

cipitating event of the phobia in this case. Other potential causes of trembling, shaking, hiding and inappropriate urination that were considered included medical problems such as pain, systemic illness, neuromuscular disease and endocrine disturbances. Through physical and basic laboratory examinations, systemic and neurologic diseases were not considered. General anxiety and attention-seeking behavior were ruled out because the anxiety and owner seeking behavior appeared only after a loud noise or thunderstorms and the dog showed the strong phobic-behaviors even the owner was present. In the clinic, inappropriate urination was easily displayed with experimentally induced loud noise and general symptoms got worsen right after the sound. Therefore, based on the history, physical examination, and laboratory testing, direct observation in the clinic and the results of the questions relating to the dogs behavior, the dog was diagnosed as noise phobia. However, the correlation between noise phobia and polycythemia was unclear.

The dog was initially treated with behavior modification with desensitization, counter-conditioning, and medication. A tape recording of storm-like sounds and the car crash sounds was played. These sounds induced a fear response from the dog, therefore, playing the recording at a low volume and gradual volume increase were recommended. Feeding the dog its favorite food or playing with favorite toy was recommended during this activity. Clomipramine (Gromin cap., Myung In Pharm), 2 mg/kg BW was administered twice daily, orally. Three weeks after the treatment, the dog showed mild improvement of the clinical signs. The intensity of the trembling, anxious behavior and frequency of inappropriate elimination during thunderstorms decreased. However, the dog still showed mild polycythemia (Hematocrit 58.47%; reference range, 37-55%). The dose of the clomipramine was increased to 3 mg/kg BW, twice daily and the music therapy with solo piano classical music (Through a Dog's EarTM, BioAcoustic Research & Development) was initiated to help with relaxation. Ten days later, the clinical signs resolved. The RBC count and hematocrit started to decrease (Hematocrit 51.52%; reference range, 37-55%) (Table 1). Two months after the initial treatment, the clinical signs resolved without side effects and the hemogram include the arterial blood gas analysis of the dog were normal. The medication dose was tapered and discontinued over the next two months. The behavior modification and music therapy were continued. No recurrence was evident 18 months later.

Discussion

According to reports described previously (8,9), polycythemia is an abnormal increase in the RBC count, packed cell volume (PCV), and Hb concentration, which can be categorized as relative or absolute. In particular, it has been reported that relative polycythemia is characterized by a transient increase in circulating RBC without RBC mass elevation due to decreased plasma volume or splenic contraction from excitement, stress, or severe pain (2,13). On the contrary, absolute polycythemia can be occurred by an increase in the RBC mass, which may be sub-classified as primary or secondary (4,7,17). In human literatures described earlier (1,6,8), moderate polycythemia is affected by chronic emotional stress, and polycythemia resulted in behavioral or mental change due to the changes of the blood flow to the brain. In veterinary medicine, only one prior report discussed a relationship between mild polycythemia and compulsive disorder (CD) (9). Although it was assumed that the dogs had absolute polycythemia because the dogs had no evidence of dehydration, the defi-

nite mechanism of polycythemia with CD was not fully understood.

In humans, chronic or acute stress decreases the plasma volume, resulting in relative polycythemia (6,16). The dog in this case had chronic noise phobia, however the dog's capillary refill time, total protein, and urine specific gravity were within reference range. Chronic stressful conditions without exercise can induce hypoxia and which can cause splenic contraction, resulting in the elevation of the hemoglobin concentration with or without polycythemia (10). In this case, the car accident was assumed to have caused the noise phobia, especially to thunderstorms, a chronic stressful event. This might have been the cause of hypoxia in this dog. The blood gas analysis showed a hypoxic condition. Hypoxia prompts the activation of the sympathetic nervous system and induces splenic contraction (1,6,16). Thus, chronic mental stress, such as the loud noise, could induce relative polycythemia due to splenic contraction in this case.

Treatment of noise phobia usually focuses on behavior modification, such as desensitization and counter-conditioning, and medications that influence serotonin metabolism (5,15,19). In this case, the dog was treated with medical treatment, behavioral modification and music therapy to improve relative polycythemia with anti-anxiolytic effect. Music therapy has been used in a variety of ways in human medicine to enhance therapeutic effects (3,12,18). In veterinary medicine, the correlation of music with behavior has not been well established. One report suggested that classical music resulted in relaxation of dogs in a shelter compared to the other types of auditory stimulation (22). Based on a previous report, a classical music was used to decrease anxiety and promote relaxation in this case. However, the exact relationship between music therapy and behavioral modification in the dog was uncertain.

In this case, the dog showed noise phobia after unpleasant event, a car accident. The fear intensity to the sharp and strong noises worsened during thunderstorm season and likely cause chronic stress in the dog. This case report describes noise phobia possibly causing relative polycythemia in a dog.

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개에서 소리공포증에 의해 발생한 상대적 적혈구증가증 증례

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요 약 : 6년령의 수컷 미니어쳐 핀셔견이 천둥소리로 인한 떨림, 빈호흡 및 부적절한 배뇨를 주증으로 내원하였다. 환축은 2년전 발생한 교통사고 이후 큰 소리에 공포감을 가지게 되었으며, 이는 천둥 발생이 잦은 지난 3개월간 지속적으로 나빠졌다. 기본 신체검사에서 미열, 빈호흡, 빈맥과 함께 혈압의 상승이 확인되었다. 실험실 검사에서 동맥혈의 산소포화도 감소와 함께 적혈구증가증이 확인되었다. 병력, 신체검사 및 실험실적 검사를 바탕으로 본 환축은 소리공포증과 함께 발생한 상대적 적혈구증가증으로 진단 되었다. 증상의 완화를 위하여, 행동교정 및 탈감각화, 반대조건화, 그리고 약물치료가 시작되었다. 다른 치료들과 함께 음악치료도 병행되었으며, 치료기간 중 임상증상 및 적혈구증가증이 개선되었다. 따라서, 본 증례는 소리공포증과 같은 만성적인 스트레스에 의하여 발생한 상대적 적혈구증가증의 진단 증례 보고 이다.

주요어 : 클로미프라민, 만성스트레스, 개, 음악치료, 소리공포증, 적혈구증가증