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NOTE

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Dynamic pharyngeal collapse in three cats with different pharyngeal pathology

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ABSTRACT. Dynamic pharyngeal collapse (PC) is a rarely reported condition in cats defined as the partial or complete collapse of the pharyngeal lumen during inspiration. Herein, we report the imaging findings and clinical features of three cats with dynamic PC. Lateral radiograph of the head was insufficient to detect dynamic PC, but fluoroscopy in conscious cats revealed dynamic PC. Magnetic resonance imaging was not helpful to reveal dynamic PC and underlying diseases. We obtained biopsy samples from the irregular nasopharyngeal mucosal membrane through endoscopy in two of the three cases and high-grade B-cell lymphoma was histopathologically diagnosed. In feline cases with abnormal upper respiratory sounds, dynamic PC should be considered, and fluoroscopy is the imaging technique of choice to diagnose the condition.

KEY WORDS: cat, endoscopy, fluoroscopy, lymphoma, pharyngeal disease

Dynamic pharyngeal collapse (PC) is defined as the partial or complete collapse of the pharyngeal lumen during inspiration [7, 11]. The collapse of the pharynx refers to a dorsal shift of the soft palate or a ventral shift of the dorsal pharyngeal wall. The collapse usually occurs during inspiration; therefore, it is not a lasting but a dynamic deviation. Dynamic PC can develop primary or secondary to various underlying diseases. Dynamic PC has been recognized as a major cause of obstructive sleep apnea syndrome (OSAS) in humans [7, 11]. However, in small animal veterinary medicine, especially cats, this condition has rarely been described. Herein, we report the clinical features and imaging findings of three feline cases with dynamic PC.

Case 1 was an 11-year-old, male, neutered domestic short hair cat that was presented to the Veterinary Medical Teaching Hospital at Nippon Veterinary and Life Science University (VMTH-NVLU) with a 9-month history of stertor. Activity and appetite of the cat was normal; however, the owner reported occasional open mouth breathing and insomnia, possibly due to respiratory problems. The referring veterinarian had prescribed several antibiotics; however, the respiratory condition of the cat did not improve. The cat had received an annual combination vaccine that included immunization against herpes virus-1, calicivirus, and panleukopenia virus. Feline immunodeficiency virus (FIV) and feline leukemia virus (FeLV) tests were negative. The cat had been treated with prednisolone intermittently for two years for chronic bronchitis at the referring hospital. On physical examination, nasal discharge, cough, and sneezing were not observed but stertor was heard during inspiration. The cat weighed 5.25 kg (body condition score 3/5) and had lost 0.5 kg in the last 9 months. No abnormal sounds were heard on thoracic auscultation. Palpable lymph nodes were not enlarged. Lateral radiographs of the head and chest revealed that the larynx shifted backwards during inspiration (Fig. 1 A1). Bronchial lung pattern was apparent throughout the lung lobes. Fluoroscopy was performed to evaluate the dynamic alteration of the pharynx to identify the cause of stertor. During inspiration, marked dorsal deviation of the soft palate was observed (Fig. 2 A1, A2). Magnetic resonance imaging (MRI) (Signa, GE Healthcare, Tokyo, Japan) and endoscopy were performed under general anesthesia with intratracheal intubation for closer observation of the nasal cavity and nasopharynx. On MRI, partial narrowing of the nasopharynx (Fig. 1 A2) and nasal discharge was detected in the nasal cavities (not shown). Mass lesions and suspected tumor lesion with Gd-enhancement were not detected. To perform endoscopy, a 5.5-mm diameter scope (flexible video endoscope OLYMPUS VQ TYPE 5112B, OLYMPUS AVS, Tokyo, Japan) was inserted from the mouth to nasal cavity with the head of the scope flexed through the laryngopharynx. Narrowing of the nasopharyngeal lumen was observed with irregular, red, and swollen mucosal membrane (Fig. 3 A1, A2). However, the lumen could be dilated by endoscopic insufflation. Two biopsy samples were obtained from the irregular mucosal membrane using biopsy forceps. Histopathological examination revealed a high-grade lymphoma. Immunohistochemical (CD20 positive and CD3 negative) and polymerase chain reaction for antigen receptor rearrangement (PARR) analysis indicated that the tumor cells were of B-cell origin. The owner declined chemotherapy and the cat was treated with prednisolone (1 mg/kg) for 6 months. The clinical signs resolved, and at 12 months

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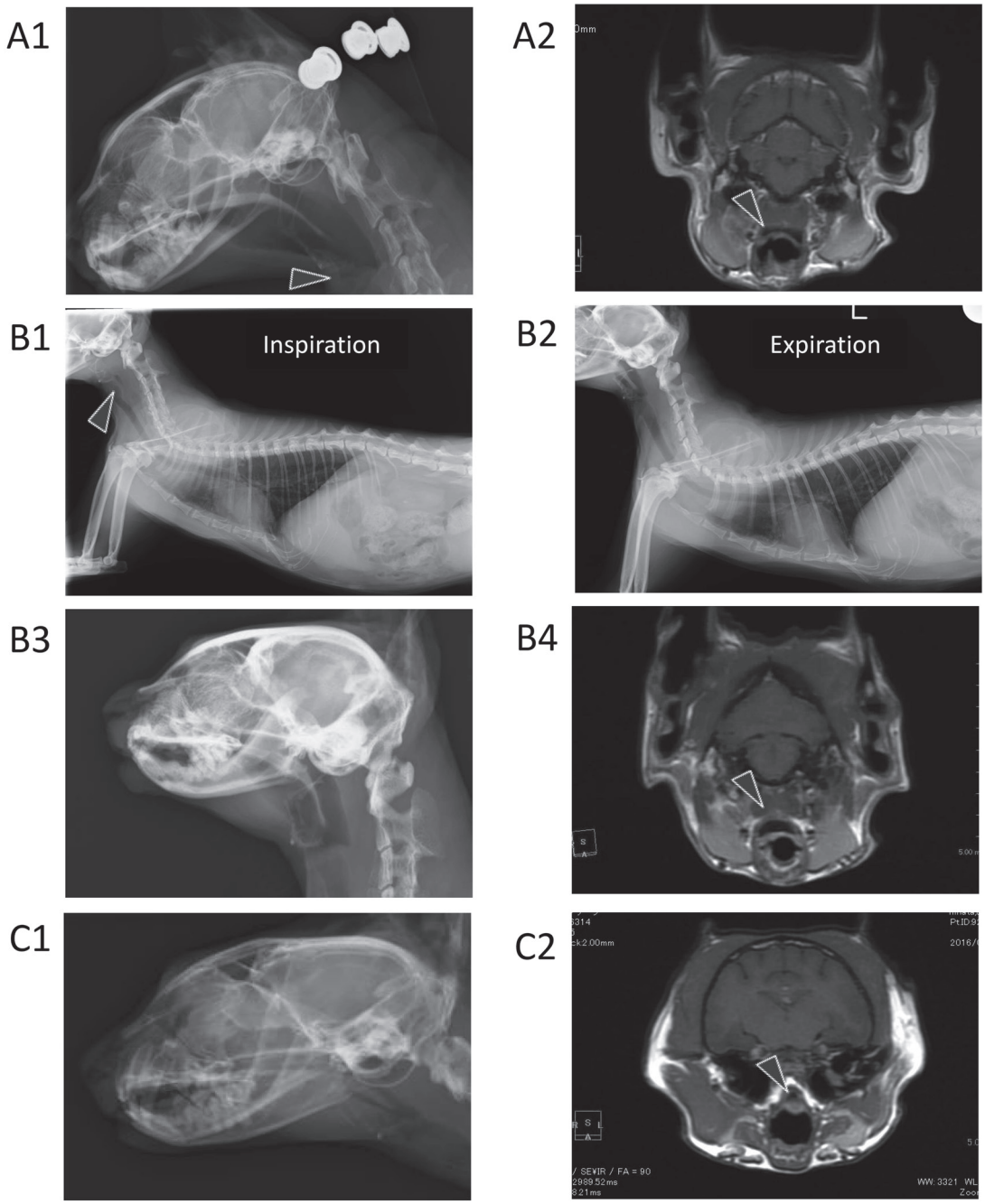

Fig. 1. A. Lateral radiographs of the head (A1) and contrast-enhanced T1-weighted magnetic resonance images (MRI; A2) in case 1. A1) The larynx space is dilated, and the larynx is shifted backwards (arrowhead). No obvious abnormalities are present in the nasal cavity. A2) The nasopharynx is partially narrowed (arrowhead). B. Lateral radiographs of the neck to chest at inspiratory (B1) and expiratory (B2) phase, lateral radiographs of the head (B3), and contrast-enhanced T1-weighted MRI (B4) in case 2. B1-2) Pharyngeal collapse at the inspiratory phase and dilation at the expiratory phase. B3) No obvious abnormalities are present in the nasal cavity and nasopharynx. B4) The caudal nasopharynx is partially narrowed (arrowhead). C. Lateral radiographs of the head (C1) and contrast-enhanced T1-weighted MRI (C2) findings in case 3. C1) Although the nasopharyngeal space is slightly narrowed, no obvious abnormalities are present in the nasal cavity. C2) Partial narrowing of the nasopharynx (arrowhead) is evident.

from the first visit to the VMTH-NVLU, the cat's condition was stable without medication.

Case 2 was an 11-year-old, female, neutered domestic short-hair cat that was presented to the VMTH-NVLU with a 2-month history of coughing and a 2-week history of labored breathing and exercise intolerance. Prednisolone (1.7 mg/kg) had been administered by the referring veterinarian for one week, following which the respiratory and general condition of the cat had improved. The cat had received an annual combination vaccine as described in case 1. FIV and FeLV tests were negative. On physical examination, the cat's general condition was stable but showed the clinical sign of tachypnea (54 breaths per min). The

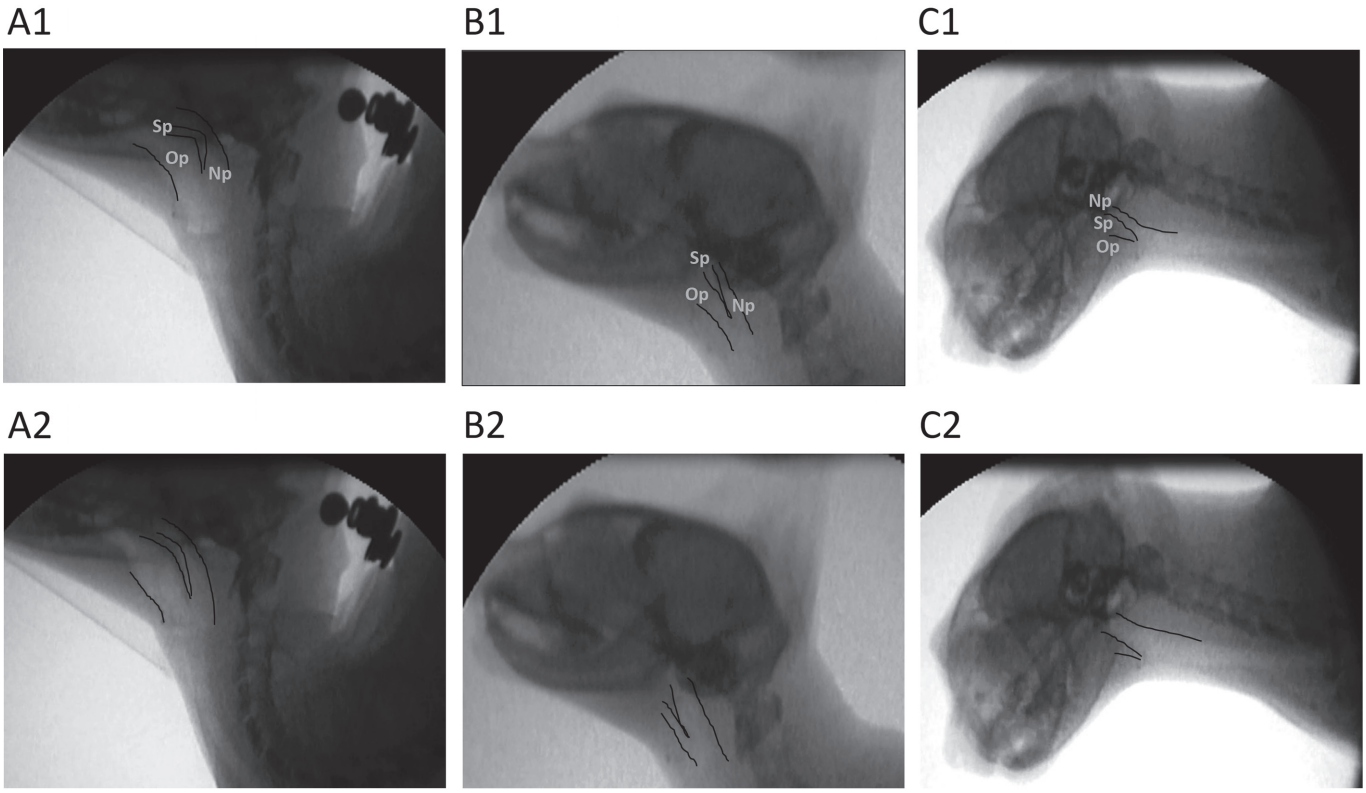

Fig. 2. Fluoroscopic images during inspiration (A1, B1, C1) and expiration (A2, B2, C2) in the lateral recumbent position. A1 and A2 refer to case 1; B1 and B2 refer to case 2; C1 and C2 refer to case 3. The margins of the pharyngeal structures are lined for clarity. A1 and B1) Apparent dorsal shift of the soft palate. C1) Dorsal shift of the soft palate and ventral shift of the dorsal pharyngeal wall. A2, B2, and C2) The pharyngeal lumen. Np, nasopharynx; Op, oropharynx; Sp, soft palate.

cat weighed 3.0 kg (body condition score 2/5) had lost 0.3 kg since the last 2 months. Stridor, suggesting tracheal secretion was heard around the cervical trachea during inspiration. No abnormal sounds were heard on thoracic auscultation. Palpable lymph nodes were not enlarged. Lateral radiographs of the thorax and neck revealed dorsal deviation of the soft palate at inspiration (Fig. 1 B1–B3). Bronchial lung patterns were apparent throughout the lung lobes and fractures were noticed in the right 10th and 11th ribs, possibly due to lasting severe respiratory effort. On fluoroscopic examination, dorsal deviation of the soft palate was observed during inspiration (Fig. 2 B1, B2). MRI and endoscopic examination were performed under general anesthesia as described in case 1. On MRI, the nasal cavity was normal; however, partial narrowing of the nasopharynx was observed (Fig. 1 B4). Mass lesions and suspected tumor with Gd-enhancement were not detected. On endoscopy, mucosal membrane of the nasopharynx was irregular, red, and swollen causing narrowing of the lumen (Fig. 3B 1, B2). However, the lumen could be dilated by endoscopic insufflation. Four biopsy samples were obtained from the irregular mucosal membrane. Histopathological examination revealed a high-grade lymphoma. Immunohistochemical and PARR analysis indicated that the tumor cells were of B-cell origin. After biopsy, bleeding from the nasopharynx was persistent and the cats developed hypotension leading to a state of shock. Although the bleeding ceased through intervention 10 hr later, the cat died of disseminated intravascular coagulopathy followed by hemorrhagic shock and acute renal injury, 18 hr after the biopsy.

Case 3 was a 1-year-old, male, neutered domestic short-hair cat that was presented to the VMTH-NVLU with an 8-month history of stertor and open mouth breathing during vigorous exercise. The owner complained that the cat would choke while drinking water. The respiratory condition of the cat had not improved with antibiotic treatment by the referring veterinarian. The cat had received an annual combination vaccination as described in case 1. FIV and FeLV tests were negative. On physical examination, the cat weighed 3.7 kg (body condition score of 3/5) and was in good general condition. Nasal discharge, cough, and sneezing were not observed; however, a stertor suggesting nasal obstruction was heard. The sound peaked during maximal inspiration and inspiratory effort was observed. No abnormal sounds were heard on thoracic auscultation. Palpable lymph nodes were not enlarged. Slight narrowing of the nasopharyngeal space was detected on lateral radiograph of the head; however, the details were unclear due to superimposition of adjacent structures (Fig. 1 C1). On fluoroscopic examination, dorsal shift of the soft palate and ventral shift of the dorsal pharyngeal wall were observed during inspiration (Fig. 2 C1, C2). On MRI, the nasal cavities were normal and the nasopharynx was partially narrowed (Fig. 1 C2). On endoscopic observation, the lumen of the nasopharynx was narrow but could be dilated by endoscopic insufflation. The mucosal membrane of the nasopharynx was normal (Fig. 3 C1, C2); therefore, a biopsy sample could not be obtained. We advised the owner to restrict the cat from performing vigorous exercise. Follow-up continued for

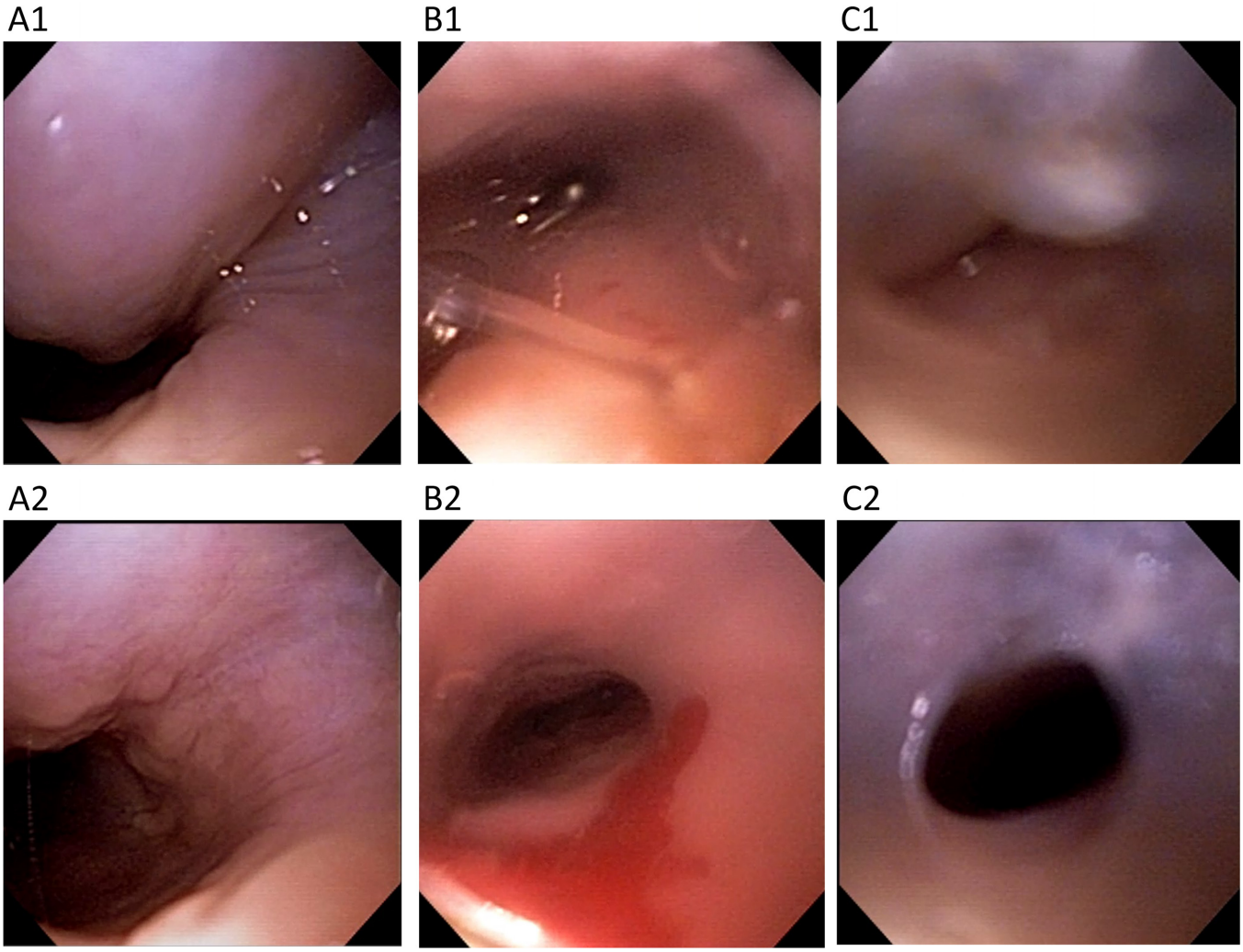

Fig. 3. Endoscopic images of the nasopharynx during collapse (A1, B1, C1) and dilation by endoscopic insufflation (A2, B2, C2). These views were obtained using a flexed scope head through the laryngopharynx. A1 and A2 refer to case 1; B1 and B2 refer to case 2; C1 and C2 refer to case 3. A1, A2, B1, and B2) The mucosal membrane of the nasopharynx is irregular, red, and swollen. C1 and C2) The nasopharyngeal mucosa is normal.

13 months, and the stertor persisted but the general condition of the cat was stable.

Dynamic PC has been well described in humans, being frequently observed in severe OSAS [7, 11]. In contrast, dynamic PC in small animals, especially cats, has rarely been described. However, a recent study described this condition in 28 dogs [12]. In the study, most of the dogs had concurrent or previously diagnosed respiratory or cardiac disorders; therefore, dynamic PC was considered secondary to long-term negative pressure between the upper and lower airways. Brachycephalic breeds, dogs being overweight or obese were reported as predisposing factors for dynamic PC [9]. Canine dynamic PC is considered a multifactorial phenomenon with unclear pathophysiology [12]. To the best of our knowledge, only one feline case with dynamic PC has been reported previously [13]. The 3-year-old male cat in the mentioned study was overweight and had concurrent lower airway disease in addition to pharyngeal disease. The features of the cat, including being overweight and with concurrent respiratory disorder were similar to those described in dogs with dynamic PC [12]. However, the clinical features of the cats described in the present report were different than those reported in dogs. Cases 1 and 2 were not overweight but had nasopharyngeal lymphoma as the putative underlying disease. Chronic bronchitis was detected as concurrent disease based on the presence of a bronchial pattern. It may be speculated that weakness of the nasopharyngeal mucosa due to lymphoma along with long-term negative pressure caused by chronic bronchitis induced dynamic PC in these cases. Underlying or concurrent disease relating to dynamic PC in Case 3 was not identified. The cat was not overweight nor had history of respiratory or cardiac disease. In some humans, nerve dysfunction due to congenital anomaly or injury has been identified to be associated with dynamic PC. Nerve dysfunction may be suspected as the underlying condition in case 3, because the owner observed that the cat would choke while drinking water. However, electromyogram-based examination of laryngopharynx nerve function [5, 6] is difficult to perform in veterinary clinical settings.

The three cases in this study and one case in a previous report [13] showed clinical signs associated with dynamic PC in

conscious, awake condition. This was in contrast to humans with OSAS. Thus, the pathogenesis of dynamic PC in cats may be different from that in humans.

Lateral radiograph taken during inspiration was insufficient, but fluoroscopy was useful for the detection of dynamic PC in our cases. As general anesthesia is required for insertion of the scope, endoscopy is not useful for the detection of dynamic PC in cats. However, the technique enables observation of the nasopharyngeal mucosal membrane and obtaining biopsy samples from the lesion for histopathological examination. Two of the three cases in this study could be diagnosed as lymphoma using biopsy samples. In previous reports investigating nasal and nasopharyngeal diseases in cats [1, 2, 4]; neoplasms were frequently diagnosed (39 to 56% cases). Of the nasal and nasopharyngeal neoplasms, lymphoma has been reported as the most common tumor [1, 3, 4]. Although nasopharyngeal stenosis (NS) is uncommon, cats with NS can exhibit clinical signs similar to those of dynamic PC [8, 10]. The primary treatment for NS is balloon dilation. However, balloon dilation may be ineffective in cats with dynamic PC as shown in a case report [13]. Thus, differential diagnosis is important in order to select the appropriate treatment. Endoscopic examination was also helpful to differentiate PC from NS. However, the feline nasopharynx is narrow, and endoscopes travel with flexed heads is restricted; therefore, biopsy cannot be performed when there are no masses or irregular mucosa in the nasopharynx. The major risk associated with biopsy of the nasopharynx using endoscopy is uncontrolled bleeding. The mucosal membrane of the nasopharynx bleeds easily owing to the abundant blood flow, and astriction is difficult. Before nasopharyngeal biopsy, coagulation tests should be performed, and haemostatic agents should be administered both intravenously and locally. As MRI is also performed under general anesthesia in animals, the technique was ineffective to detect dynamic PC in this study. Tumor suspected lesion was not detected on any image obtained including Gd-enhanced T1WI in the two cases with lymphoma. The lesions may be too small to be detected on MRI in these cases.

In summary, dynamic PC was observed in three cats that presented with abnormal upper respiratory sounds, including stertor or reverse sneeze without obvious nasal discharge. Fluoroscopy in conscious cats was useful for the detection of dynamic PC. Endoscopy was also useful to observe abnormality of the mucosal membrane and to obtain biopsy sample to histopathologically identify the underlying disease. Although an effective treatment for dynamic PC is currently lacking, appropriate treatment of the underlying diseases might improve clinical signs caused by dynamic PC.

CONFLICT OF INTEREST. None of the authors of this paper have financial or personal relationships with other people or organizations that could inappropriately influence or create bias in the content of the paper.

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