Journal MVZ Cordoba
2020; 25(3):e1923.
https://doi.org/10.21897/rmvz.1923

Clinical case

Intraluminal use of dual nitinol stent for complete collapse of trachea in a Canine Maltese breed

Rodrigo de Lavalle G[1*] Esp; José Pinzón D[2] MVZ; Ariel Mendoza D[1] MVZ; Amanda Ramos R[3] MVZ; Jorge Guzmán[1] MVZ; Teresa Oviedo S[1] D.Sc; Mario de la Puente[4] Ph.D.

[1]Universidad de Cordoba, Facultad de Medicina Veterinaria, Colombia.
[2]Veterinaria Sabuesos, Barranquilla, Colombia.
[3]Veterinaria Mastervet, Barranquilla, Colombia.
[4]Universidad del Norte, Grupo de investigación, Barranquilla, Colombia.
*Correspondencia: rdelavallegalvis42@correo.unicordoba.edu.co

Received: February 2020; Accepted: July 2020; Published: August 2020.

ABSTRACT

Canine patient, Maltese breed, female gender, castrated, 4 years old and 5 Kg of weight. The main reason for consultation was cough and severe respiratory distress. During the clinical evaluation, the patient presented cyanosis, severe inspiratory and expiratory stridor, squawking cough, especially after emotional stimulation. A bronchoscopy was performed that revealed a dynamic decrease in the diameter of the tracheal lumen, a severe collapse in the cervical and thoracic portions. Due to the severity of the tracheal collapse, the implantation of a nitinol stent was decided. The choice of stent is essential and therefore it was necessary to perform a measurement of the diameter and length of the trachea to minimize side effects and rejections. The trachea presented diameter variability at the thoracic level, which is why it was decided to use a dual stent, which was placed by direct observation through a pediatric bronchoscope. We present a case in which a dual stent was used, indicated in cases in which the diameter of the trachea varies along its path. Excellent results were obtained since it was adjusted to the different diameters that the trachea presented at the cervical and thoracic levels.

Keywords: Cough; dog; dyspnea; trachea (*Source: DeCS, AIMS*).

RESUMEN

Paciente canino, de raza maltés, género femenino, castrado, de 4 años y 5 Kg de peso. El motivo principal de consulta fue tos y dificultad respiratoria grave. Durante la evaluación clínica, el paciente presentó cianosis, estridor inspiratorio y espiratorio severo, tos en graznido especialmente después de un estímulo emocional. Se realizó una broncoscopia que reveló una disminución dinámica en el diámetro de la luz traqueal, un colapso severo en las porciones cervicales y torácicas. Debido a la gravedad del colapso traqueal, se decidió la implantación de un stent de nitinol. La elección del stent es fundamental y por tanto fue necesario realizar una medición del diámetro y la longitud de

How to cite (Vancouver).
de Lavalle GR, Pinzón DJ, Mendoza DA, Ramos RA, Guzmán J, Oviedo ST, de la Puente M. Intraluminal use of dual nitinol stent for complete collapse of trachea in a Canine Maltese breed. Rev MVZ Cordoba. 2020; 25(3):e1923. https://doi.org/10.21897/rmvz.1923

ISSNe: 1909-0544

la tráquea para minimizar los efectos secundarios y los rechazos. La tráquea presentó variabilidad del diámetro a nivel torácico, razón por la cual se decidió utilizar un stent dual, el cual se colocó mediante observación directa a través de un broncoscopio pediátrico. Se presenta un caso en el que se usó un stent dual, indicado en casos en que el diámetro de la tráquea varía en su trayecto. Se obtuvieron excelentes resultados ya que se ajustó a los diferentes diámetros que presentó la tráquea en los niveles cervical y torácico.

Palabras clave: Disnea; tráquea; perro; tos (*Fuente: DeCS, AIMS*).

INTRODUCTION

Tracheal collapse (TC) involves a variety of tracheal conditions characterized by tracheal ring cartilage degeneration in which hypocellularity and the decreased glycosaminoglycan and calcium content causes dorsoventral flattening of the trachea and laxity of the dorsal membrane. The result is a dynamic collapse of the upper airways, characterized by being a progressive disease (1). It is a common pathology in miniature and small dogs that can attack the cervical, thoracic, or both regions (2), and presents different degrees of obstruction (3).

The etiology of the disease is not known (3). No gender bias has reported; generally, TC diagnosed in dogs of all ages. However, 24% of affected dogs have the first symptoms at six months of age (4). There are acquired and fundamental components proposed as a cause of the weakness of the tracheal cartilages (5). Many dogs remain asymptomatic to a later age with degenerative changes of the tracheal cartilage and secondary factors that trigger the clinical syndrome of TC (1). Secondary factors related to the appearance of clinical signs include respiratory tract irritation, chronic bronchitis, laryngeal paralysis, respiratory tract infection and obesity and tracheal intubation (6).), as well as postulated alterations of the elastic fibers in the dorsal tracheal membrane and the annular ligament (1).

The most frequent signs of the disease in an elective evaluation are a cough, restrictive respiratory pattern or stridor. Chronic signs are manifested with intermittent coughing, honking cough, noisy breath, and owners remarking that the symptoms get worse when the animal gets excited. In the majority of the population, they can present themselves as an emergency due to airway obstruction (7).

Numerous surgical procedures are described as palliative treatments for TC. Extraluminal stenting is the most common technique that which provides support for tracheal cartilages and is associated with several complications such as laryngeal paralysis, tracheal necrosis (8), loss and failure of the implant (9). Surgical management of the thoracic trachea tends to be difficult due to the migration of intraluminal devices and the inability to apply extraluminal supports (2).

Canine TC can be successfully treated with the placement of intraluminal nitinol stents (8). Intraluminal stents can provide a therapeutic alternative when tracheal collapse is severe for the patient. Among the advantages of the use of stents include a short period of anesthesia, immediate improvement of clinical signs and a minimally invasive surgery of the cervical and thoracic tracheal portions (3). Currently on the market is Vet Stent-trachea® (Infiniti Medical, LLCTM, Malibu, CA) which is a self-expanding nitinol endoprosthesis of equal diameters.

Normally, the trachea has a cylindrical shape and linear measurements, however, the dimensions of the trachea in these patients vary, for this reason they do not have the same dimensions over their entire length, this leads us to present later complications when using a stent with the same dimension. The new duality stent Vet Stent® (Duality tracheal stent, Infiniti Medical LLC, Menlo Park, CA) is indicated to cases where the diameter of the trachea varies and in this way the anatomical difference is minimized (7).

This report presents a case of severe tracheal collapse with a different diameter at cervical and thoracic level, successfully treated with the use of a new duality stent Vet Stent® (Infinity Medical Stent, Infiniti Medical LLC, Menlo Park, CA).

Anamnesis. To the Emergency Center of the Mastervet Veterinary Clinic of Barranquilla, Colombia, a canine patient enters for an evaluation, Maltese, female, castrated, four years old and 5 Kg. of weight. The main reason for the consultation was cough and severe respiratory distress. TC is initially diagnosed and managed

at 12 months of age in the reference clinic. The initial clinical signs were cough, snoring (which increased over time) and exercise intolerance. The patient was intermittently treated with anti-inflammatory therapies (corticotherapy), antibiotics, and bronchodilators. The owners observed that a slight improvement with medical therapy, but with the passing of the days their respiratory problems worsened. The day was presented the episode, the patient barked for several hours, continuing an intense cough that generated severe respiratory dyspnea, requiring treatment with oxygen and dexamethasone. The thoracic radiograph revealed TC (Figure 1), so the patient was referred for a more thorough evaluation of the veterinary center Mastervet with subsequent treatment.

Figure 1. Right lateral-lateral radiograph of the neck and chest of the patient. The trachea presents a decrease in diameter at the cervical level, entrance to the thorax indicating a collapse.

Clinical examination findings. During the clinical evaluation, the patient presented cyanosis, severe inspiratory and expiratory stridor, so oxygen therapy, bronchodilators, and butorphanol (0.5 mg/kg IM) were quickly started, achieving clinical stabilization; a cough was honking cough especially after an emotion. The blood count, biochemical profile and urinalysis revealed no abnormalities.

Diagnostic aids used. An examination was performed through an exhaustive bronchoscopy, revealing a dynamic decrease in the diameter of the tracheal lumen (severe collapse of the cervical and thoracic portion) with the presence of mucus and congestive areas in the tracheal mucosa, besides, dynamic collapse of the left main bronchus (bronchial collapse) (Figure 2).

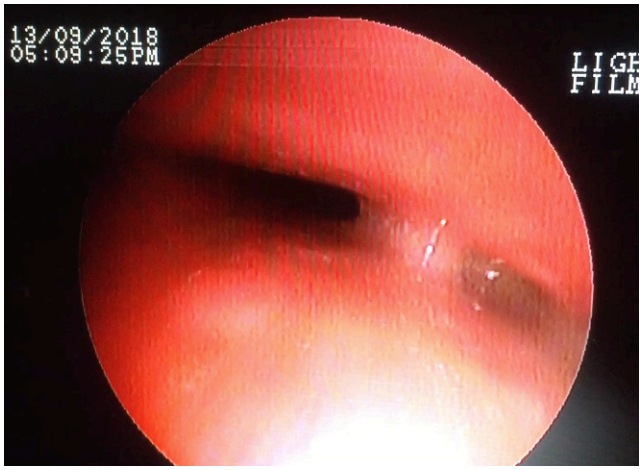

Figure 2. Bronchoscopy view of the patient, showing a severe degree of collapse of the trachea at the cervical and thoracic levels.

The measurement for stent selection was made on lateral chest x-rays obtained with 20 cm of positive pressure of H2O. The patient is placed in right lateral recumbency with the neck flexed to align the trachea as best as possible. A 5 Fr hydrophilic guide catheter marker was placed in the mouth and advanced over the esophagus to encompass the entire length of the trachea. Radiograph with the radiopaque marker was brought to magnified to compare it with the guide marker and determine the diameter and length of the stent by segments (5). Finally, the stent dimensions were determined according to the manufacturer's recommendations, which would include the entire trachea without reaching the larynx.

Treatment approach. The patient was kept in the critical care unit receiving azithromycin (10 mg/kg, PO every 24 hours), prednisolone (0.5 mg/kg, PO, every 12 hours), aminophylline (10 mg/kg, IV, every 8 hours) and oxygen therapy when needed it. Nebulizations with sterile saline, acetylcysteine, dexamethasone, and aminophylline were performed every 12 hours.

Due to the severity of the collapse, the implantation of a nitinol stent was decided for TC treatment. When measuring the diameter and size of the stent to be implanted, it was identified that the measurement of the trachea was not uniform, for this reason, it was decided to use the Duality Stent Vet®, which is indicated

to cases where the diameter of the trachea is variable. It is in an endoprosthesis of varying size that closely adjust to the diameter of the trachea at all points, something that the conventional endoprosthesis does not achieve. The dimensions of the stent were determined according to the manufacturer's recommendations.

The stent was placed under direct observation using a pediatric bronchoscope. The patient was anesthetized (premedicated with butorphanol 0.4 mg/kg and propofol maintenance 5 mg/kg IV) in right lateral recumbency. The bronchoscope was inserted into the trachea to the level of the carina. The stent delivery system was entered adjacent to the bronchoscope, the latter was retracted approximately 5 mm from the bifurcation of the trachea, and the stent was partially deployed at the level of posterior collapse, 1 cm posterior to the carina. Then, the stent was deployed and at the same time the bronchoscope was retracted throughout the trachea while the stent was deployed. Before completing the entire deployment in the trachea, an x-ray is performed to confirm its position; being positioned correctly, the stent is fully deployed. Once the stent is fully deployed, the bronchoscope is inserted again to verify the precise placement of the stent (Figure 3-4).

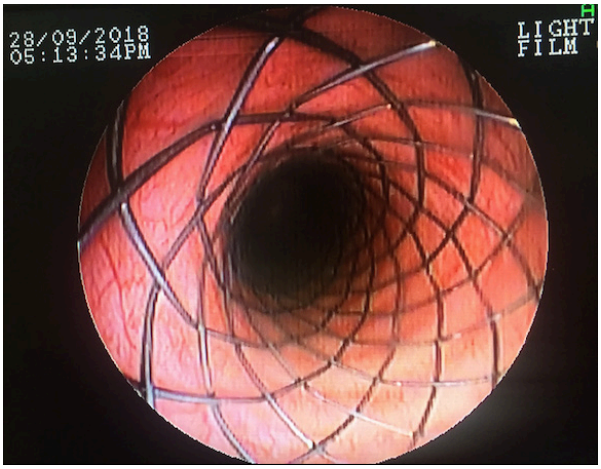

Figure 3. Bronchoscopy view of the patient's trachea with a dual intraluminal stent implanted in a collapsed trachea.

The use of oxygen was not necessary in the patient's postoperative, since the recovery from anesthesia was successful and his breathing went from severe inspiratory and expiratory distress that he presented before surgery, to normal after the procedure.

Figure 4. Right lateral radiograph of the neck and thorax after stent placement. Stent radiopaque object with endoluminal location in the trachea, from the middle cervical portion to the thoracic portion of the trachea.

In the postoperative period the standard protocol that included antitussives was used: dihydrocodeine (1 mg/kg PO, every 8 hours), antibiotic therapy: ampicillin-sulbactam (20 mg/kg PO, every 12 hours), anti-inflammatory drugs: prednisolone (1 mg/kg PO, every 12 hours, decreasing the dose after 2 weeks). During the postoperative period, the patient presented a severe and mild intermittent cough for 20 days, decreasing with time, until it presented an occasional cough at 45 days. At the time that presented a cough crisis, nebulizations were performed with sterile saline and aminophylline. It is important to mention that at no time after the procedure did I present respiratory distress.

DISCUSSION

Conservative management is only 71% effective in dogs treated with TC; 11 out of 100 dogs evaluated required surgical treatment due to the degree of collapse (4). Routine recommendations include maintaining an optimal body condition, use of anti-inflammatory drugs such as corticosteroids to reduce airway inflammation, bronchodilators to decrease airway resistance, tranquilizers if needed to prevent excitement, and antitussives to decrease

the presence of a cough (8). The patient received adequate management and treatment for a time, improving and controlling her clinical signs, but the progress of TC the disease progressed to a degree of severe respiratory distress and as reported in these patients with severe collapse the recommended treatment is the placement of a stent (9), the use of it was chosen, since the studies show advantages over surgical extraluminal prostheses.

Nitinol stents are available in a variety of sizes and shapes for use in different lengths and tracheal diameters. For this reason, the use of nitinol stent may be a treatment option for dogs with TC. Currently, the need to carry out an accurate measurement of the diameter and length of the trachea by segments is described to obtain an accurate measurement of the stent and thus avoid subsequent complications such as stent migration, mucus retention due to the alteration of the mucociliary transport system and stent fractures (3).

65-78% of patients that presents TC respond to medical treatment, reducing the severity and presentation of clinical signs. However, 22-35% require salvage surgical treatment due to complicated tracheal disease. The use of a tracheal stent has advantages over conventional medical and surgical management. It includes less time in anesthesia, immediate improvement of clinical signs related to TC, decrease in the prescription of medications used for this pathology and the ability to implement non-invasively. These factors contribute to the improvement of the quality of life of the patient and the owners (5). The most common indications for stent placement include patients with intractable dyspnea, gaping cough or cough associated with tracheal collapse (7), clinical signs presented by the patient.

The trachea presents a significant variability in diameter, the use of the new duality stent Vet Stent ® (Duality tracheal stent, Infiniti Medical LLC, Menlo Park, CA) is indicated to address these cases where the diameter of the trachea varies and thus minimize the differences anatomical (7), situation that occurred in our patient where the diameter of the cervical trachea was 11.7 mm, at the level of the thoracic inlet it was 11.7 and in the thorax 8.7 mm, for this reason a Duality Stent Vet was chosen to minimize the side secondary effects of the diameter difference. The placement of the stent by fluoroscopy is recommended (8), but recently it has been described that by direct observation by bronchoscopy its deployment and use in canines is possible, presenting several advantages with respect to fluoroscopy, finding a decrease in the surgeon's error because there is direct observation of the caudal aspect of the stent, decrease in exposure to ionizing radiation, availability of equipment and a decrease in operating time (3). The placement of the stent did not present any complication when performing this technique. Poor placement is a frequent complication, the stent can be placed in the carina or the main bronchus resulting in a persistent cough or occlusion of a lobar bronchus, the stent can also be placed erroneously in the larynx or the endotracheal tube (7), none of these problems occurred in our procedure thanks to direct observation through the bronchoscope.

Perioperative risks to stent placement such as emphysema and pneumomediastinum are described (9), in our case there was no perioperative problem. The stent is associated with several postoperative complications such as a transitory cough, laryngeal spasm, perforation of the tracheal mucosa and stent fracture. The majority of failed stent implants result from an underestimation of the diameter at which fracture, collapse of the stent and excessive growth of granulation tissue may occur (10). If the size is underestimated, it will not be in contact with the mucosa due to a small diameter and can be expelled from the airway (2). When the size is overestimated, necrosis may occur, perforation of the tracheal wall resulting in pneumomediastinum, pneumothorax (5), stent fracture (7), or metaplasia and ulceration (11). Postoperative mortality is 11% at 60 days and 25% at six months, our case did not present any complications, only severe and mild intermittent cough for 20 days, decreasing over time, until presenting sporadic cough at 45 days. This situation can be generated by the collapse of the bronchus or secondary irritation of the stent, bacterial tracheitis or tracheitis (8). The medical team considered that a cough was not due to a collapse of the bronchus but to the secondary irritative process of the mucosal stent as mentioned in another study (5).

Weekly, pet owners are contacted for follow-up. One month after the procedure, in-person control is carried out and perform thoracic radiographs. Finally, a quarterly control is scheduled until the year of stent implantation. If clinical abnormalities develop before the expected time, the patient should be reevaluated.

Dogs with TC that present a threat to their lives due to obstruction of the airway or refractory to conservative treatment options are candidates for the placement of a self-expanding metal stent. By knowledge of the authors, the placement of this stent is one of the first inserted it in Colombia, this is not a new concept of TC treatment, but the use of the Duality Stent Vet can improve the side effects of stenting, equal diameter when used in tracheas with various diameters.

Conflict of interests

The authors of the current study declare that there is no conflict of interest with the publication of this paper.

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