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Case Report

A dorsal sling technique in a dermoid sinus dog with nuchal ligament excision

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Abstract

A dorsal sling technique for correction of nuchal ligament excision in a dermoid sinus canine case is presented in this report. At surgery, there were multiple tubes of the dermoid sinus tracts of different types. The nuchal sinus was treated using a segmental resection at the area of involvement and a dorsal sling technique was performed. The dog recovered uneventfully and regained normal daily activities within a short time after surgery. The technique was accomplished as evaluated by non-pain normal motion of the cervical region and no complications were found during the follow-up period. This is the first report on the performance of the dorsal sling technique for stabilization and support after a canine nuchal ligament resection in a rare case of multiple dermoid sinus types. Further investigation is needed to evaluate the long-term consequences and benefits of this technique.

Keywords: canine, dermoid sinus, dorsal slings, nuchal ligament

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Introduction

Dermoid sinus is a defect occurring during early embryogenesis (Antin, 1970; Lord *et al*., 1957; MacPhail, 2013[b]). The failure of separation between the neuroectoderm and ectoderm creates a cylinder tubular appearance and entraps the skin structure internally which extends with the neural tube folding ventrally (Kaplan *et al*., 2005). Dermoid sinus is a rare congenital inherited disease (Salmon and Andersson, 2006). In veterinary medicine, this defect is classified into six unique groups. A type I dermoid sinus tract extends to the supraspinous ligament or nuchal ligament creating communication with the skin. Type II involves the supraspinous ligament by a fibrous stand. In type III, the sac ends before reaching the supraspinous ligament and does not attach the ligament with a fibrous stand. A type IV tract is associated with a vertebral canal and dura mater. Type V is a blind sac located between the skin and the vertebrae. A type VI sinus tract attaches the supraspinous ligament and then extends the fibrous stand to the dura matter. Dermoid sinus can be further subdivided into subtypes by its location on a part of the body: (a) vertebral canal, (b) cranium and (c) nose, (Bornard *et al*., 2007; Kiviranta *et al*., 2011; Perazzi *et al*., 2013).

The sinus contains hair follicles, sebaceous glands and sweat glands histologically which fill the tract with debris and sebum. When infection of the sinus occurs, negative conditions, such as abscess forming, swelling, pain, meningitis, myelitis, encephalitis and life-threatening symptoms can be the consequences (MacPhail, 2013[b]; Motta *et al*., 2012; Pratt *et al*., 2000). There is a wide range of diagnosis methods from physical examination to several diagnostic imaging techniques, including plain and contrast radiography, ultrasonography, computed tomography and magnetic resonance imaging. Additionally, neurological examination, myelography and/or cerebrospinal fluid analysis can be considered as diagnostic tools in the case of type IV with the tract involving neurological structures or for meningitis or meningomyelitis caused by infection to the dura matter or subarachnoid space (MacPhail, 2013[b]; Miller and Tobias, 2003; Pratt *et al*., 2000; Rahal *et al*., 2008). Treatment has involved surgical excision of the sac and treatment of its association with infection and/or other anomalies (Kerwin *et al*., 2018; MacPhail, 2013[b]). During the cervical sinus resection, the nuchal ligament should be preserved. If the ligament is split, reconstruction can be performed using a variety of techniques (MacPhail, 2013[b]). Nonetheless, the current case report is the first to describe a dorsal sling technique to stabilize the nuchal ligament-segmental-deficient cervical vertebrae and this is the first reported case of multiple dermoid sinuses of types Ia and IIa in the neck of a crossbreed dog.

Clinical description

A 6-year-old, 15.5-kg, intact female Beagle dog was A nine-month-old, mixed-breed, intact male dog weighing 15.9 kg was referred to Kasetsart University Veterinary Teaching Hospital, Bangkok, Thailand with complaints of a draining sinus at the dorsal back for 6 months. Physical examination of the dog revealed three soft fluctuated masses at the mid-dorsal neck approximately 1x2 cm, 2x3 cm and 1x2 cm in size. There were tubular structures extending underneath the masses into the deep soft tissue layer and the dog showed signs of discomfort with attempted palpation. The mass was aspirated for evaluation. An amount of seropurulent fluid was obtained. Cytology and a bacteriological culture were provided with this sample. Although the total leukocyte count showed an increase (26.1 $\times 0^3/\mu l$), the other results were normal. The dog was prescribed amoxicillin/clavulanic acid (20 mg/kg q12h) for 7 days and carprofen (2.2 mg/kg q12h) for 5 days. One week after first presentation, the clinical signs had improved without pain on mass palpation. The laboratory result noted an inclusion cyst with the *β-staphylococcus intermedius* group and the previously prescribed antibiotic drug was one of the drug sensitivity results. The masses were smaller in size and the inflammation tissue had improved; the dermoid sinus was suspected with gross lesions on external palpation. The owner refused a fistulogram and computed tomography to investigate the extension and other organ involvement in these sinus tracts. The dog continued with the prescribed antibiotic for two weeks and surgery was performed. The complete blood count and biochemical profile values were within the normal limits in the subsequent appointment, one day before the surgery.

The dog was anesthetized and positioned in sternal recumbency with towels placed under the neck to slightly elevate the cervical vertebrae. An elliptical incision was made around the dermal sinosal tract from the level of the external occipital protuberance to the dorsal spinous process of the 1st thoracic vertebra. The subcutaneous fascia and the dorsolateral superficial cervical musculature were dissected carefully to preserve the sinus tract intact. The pairs of splenius muscle and the biventer cervicis muscle were partially resected around the sinus-attached regions. Gelpi retractors were used at the cranial and caudal aspect of the surgical area to provide an approach. The hemorrhage was controlled by monopolar cautery. The dissection was deepened through the surrounding connective tissue until the nuchal ligament was exposed.

Three dermoid sinus tracts were presented. The pear-shaped end sac of the first tract was attached to the dorsal edge of the nuchal ligament at the C3 level. The second tract extended as a cylindrical sac through the nuchal ligament. The third tract ended with a small sac in the overlying muscle, then reached the fibrous band penetrating the nuchal ligament to the underlying tissue (Fig. 1).

Sharp and blunt dissection was performed on the nuchal ligament to follow the tract. The deep muscles including the spinalis cervicis and multifundus muscles were blunted and the tendinous attachments to the dorsal spinous processes were resected where the dermoid sinus tracts had been removed completely. The second tract terminated at the spinous process of C5 and the fibrous tract of the last one ended in the spinalis cervicis muscle dorsal to the spinous process of C7. As a result of the lack of sufficient residual nuchal ligament and the high tension for

direct reconstruction, a dorsal sling technique was performed.

Two holes were drilled transversely in the craniodorsal area of the spinous process of the axis and the 1st thoracic vertebra about 1 cm from the dorsal and cranial edge. An 80 lb nylon leader line was used. Each end of the suture was threaded through each single hole in a figure-of 8 pattern. The cranial end passed from right to left at the axis and the caudal end was passed through a metallic crimp tube before entering the hole on the 1st thoracic vertebra from left to right. Then, these pair ends were fed through the metal crimp tube. Finally, the suture was tensioned adequately to the feeling of an intact nuchal ligament suggested by palpation, and the crimping forceps were used to hold the suture in place by applying 3 spaced crimps on the metal tube, which made the tension of the nylon leader line stable. Then, the suture ends were secured with a series of square knots (Fig 2). A closed active suction drain (MILA International Inc., USA) was placed under the musculature layer to establish drainage and dead space management. The muscles, the subcutaneous connective tissue and the skin were closed routinely.

The dog recovered uneventfully. The closed active suction drain was removed 5 days after surgery. The dog was noted to be capable of flexing and extending the cervical area postoperatively and the wound healed without any complications (Fig 3). The dog had normal daily activity during the 12 months of follow-up by telephone contact with the owner.

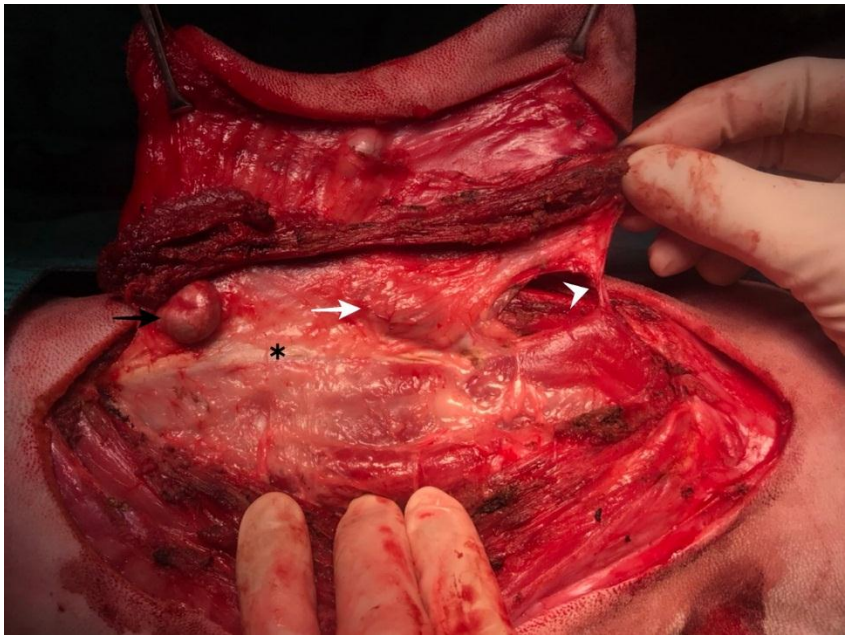

Figure 1 Intraoperative photographs of the cervical dermoid sinus: The pear-shaped end sac of the first tract (dark arrow) is located at the dorsal edge of the nuchal ligament (asterisk), the second tract is a cylindrical sac (white arrow) embedded into the nuchal ligament and the third tract ends over the muscle and then the fibrous band (white arrowhead) penetrates the nuchal ligament to the underlying tissue.

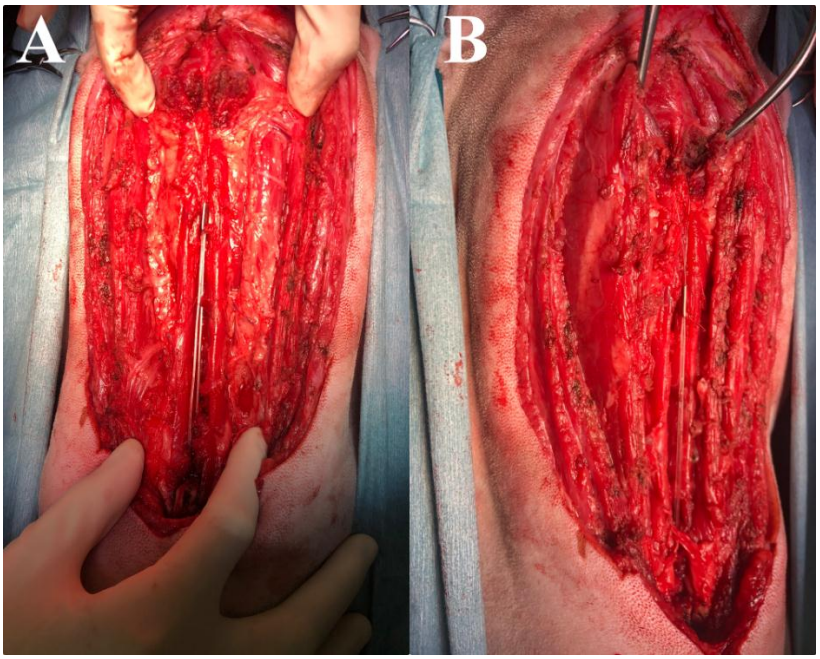

Figure 2 Intraoperative photographs of the dorsal sling: (A) Dorsal view and (B) Dorsal oblique view.

Figure 3 Postoperative photographs on 10th day; the dog was able to move the neck in a normal direction without any remarkable complications.

Discussion

Dermoid sinus can be identified as involving multiple or a single sinus tract (MacPhail, 2013[b]). In veterinary medicine, six types of dermoid sinus can be identified based on the extent of penetration into the underlying tissue (Booth, 1998; Kiviranta *et al*., 2011; Mann and Stratton, 1996). All these types can be further classified in three subtypes depending on the anatomical location (Bornard *et al*., 2007). The cervical sinus commonly lengthens to the dorsal spinous process of the second cervical vertebrae (Randy and Robert, 1979). The combination of multiple types of cervical dermoid sinus is very rare, though the veterinary literature contains examples, including one case of types IIa and IIIa and another case of types Ia, IIa and IIIa (Booth, 1998; Mann and Stratton, 1996) Most cervical sinus cases typically present with a palpation of the cylinder tube under swollen skin on the dorsal area and some cases have a chronic discharging sinus, as was found in the current case. Neurological signs can be presented in cases of the sinus tube extending to the dura matter of the spinal cord and can cause infection, which is unusual and has only been reported in the thoracic and lumbosacral regions. (Bowens *et al*., 2005; Fatone *et al*., 1995; Lord *et al*., 1957; Pratt *et al*., 2000; Selcer *et al*., 1984) The dog in our case report presented multiple tubes of cervical dermoid sinus; two tubes were type I extending to the nuchal ligament, where one of them ended as a blind sac at the level of the dorsal spinous process. The other one was type II with the sac ending in the intramuscular layer but extending the fibrous band into the underlying tissue just beneath the nuchal ligament.

Diagnostic tools (radiography, fistulogram utilizing ultrasonography, computed thermography, myelography and magnetic resonance imaging) are effective for more accurate identification of the location, surrounding soft tissue and other associated organ abnormalities in dermoid sinus cases before performing the treatment (MacPhail, 2013[b]; Kowaleski *et al*., 2018; Rahal *et al*., 2008). However, the owner in the current case not only had limited financial means but there were non-neurogenic signs presented that limited us to elect for surgical removal and exploration. Without preoperative advance diagnostic tools, surgery of the nuchal ligament involvement during the sinus tract excision was not planned.

The nuchal ligament is found in ungulates and many kinds of long-legged canid species but is lacking in felid species (Wang and Tedford, 2008; Loscher *et al*., 2016). In modern dogs, the nuchal ligament is important for their scent trail behavior, which prevents separation of the spinous process of the vertebrae and supports the muscular effort to stabilize the head (Wang and Tedford, 2008). The ligament is located at the dorsal spinous process and extends from the axis to the first three thoracic vertebrae and runs in the dorsocaudal direction as the supraspinous ligament.

If necessary, the nuchal ligament can be transected without any reported clinical effect as mentioned in a nuchal ligament technique for atlantoaxial subluxation correction that cut the caudal attachment of pre-divided ligament and inserted them under the dorsal arch of the atlas before both ends were tied together through predrilled holes on the axis (LeCoteur *et al*., 1980). The caudal attachment of the ligament is disassembled during resection of the spinous process of T1-T3 in the dorsal approach of the cranial thoracic vertebrae (Coates *et al*., 2003).

Commonly, the nuchal ligament should be preserved. In dermoid sinus dissection procedures and a dorsal approach to the mid cervical vertebral column, leaving this ligament intact can be performed by an incision that is made on the muscle along the lateral side of the ligament and retracting the ligament with the muscle to the opposite side of the incision. (MacPhail, 2013[b]; Piermattei, 1993). Additionally, the

attachment of the ligament can be preserved in the dorsal approach to cranial thoracic vertebrae by separating the ligament midline longitudinally or with limited cutting of the dorsal arch of the spinous process and preserving the ligament attachment on the remaining spinous process (Coates *et al*., 2003; Kerwin *et al*., 2018).

Multiple techniques have been described to reconstruct the transected nuchal ligament including specific suture configurations, such as a locking loop pattern and modified Bunnell suturing in which two cruciate sutures are placed at one end and repeated at the other end of the disrupted ligament. This technique is infrequently used due to its difficulty and the likely resulting damage to the tendon or ligament (MacPhail, 2013[a, b]). The approach using the closure of the dorsal mid-cervical vertebrae technique recommends securing the nuchal ligament to the axis by non-absorbable suture material passing through the predrilled holes in the spinous process of the axis (Piermattei, 1993).

Nonetheless, no previous procedure has been reported to stabilize the segmental nuchal ligament-deficient cervical vertebrae and there has been no adverse consequence of post-complete ruptured ligament reported in canine patients. Consequently, the reconstruction and stabilization in our case was chosen to prevent long-term postoperative complications and to support the cervical muscle to flex the neck.

Our technique was performed using monofilament nylon leader line thread through predrilled holes in the dorsal spinous process at the origin of the nuchal ligament attachment. The suture ends were tensioned and fastened using a metallic crimp tube, which replaced the large knot normally required. Monofilament nylon leader line is a popular, long-lasting prosthetic material used for extra-capsular cranial cruciate ligament repair as a lateral fabella-tibial suture in small animals. The procedure is quick and easy to apply relative to other techniques and has a good strength outcome (Flo, 1975; Peycke *et al*., 2002). The nylon leader line is preferred to other nylon lines due to its better stiffness under the given load, a higher failure load, low bacterial adherence, a recover resting tension to a greater degree and a physiological tolerance to stream or ethylene oxide sterilization (Banwell *et al*., 2005; Caporn and Roe, 1996; Lewis *et al*., 1997; Nwadike and Roe, 2008). The strength of the chosen leader line should be at least equivalent to the body weight of the patient in extracapsular stabilization for canine cranial cruciate ligament repair (Kowaleski *et al*., 2018). In our case, partial support for cervical musculature was the reason for using this technique. A limitation of this study was that the *in vivo* physiological forces of the canine nuchal ligament had not yet been defined and this limited an informed decision on the appropriate size of the nylon leader line to use. Postoperatively, we were able to obtain clinical information via physical examination for early postoperative follow up and phone calls later (at 3 and 12 months after the surgery) and no post-operative complications were reported.

The study revealed that the dorsal sling technique for stabilization of the segmental nuchal ligament-deficient cervical vertebrae was a quick procedure without postoperative complications. This technique has not been reported previously in dogs. However, the beneficial outcomes should be further estimated and compared with non-correction cases in the future.

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