CLOSED INCISION MANAGEMENT WITH NEGATIVE PRESSURE WOUND THERAPY AFTER FORELIMB AMPUTATION IN A DOG

by

Mei Lin GO

Promotor: Prof. Dr. Hilde de Rooster
Co-promotor: Nicolas Vallarino, DVM

Case report as part of the Master's Dissertation

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PREFACE

I would like to thank my promotor Prof. Dr. Hilde de Rooster and my co-promotor Nicolas Vallarino, DVM, for giving me feedback on this report. It helped me to improve this report as much as possible in a relatively short period of time. Also, I want to thank the owner of the patient described in this case report. She agreed to meet me and was very welcoming. I was allowed to take as much photos and videos as I wanted. It was amazing to see the dog running and playing. The owner was so grateful for the care of all veterinarians and students of the faculty in Merelbeke: "the dog was his old self again".
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ABSTRACT

A male castrated German shepherd of 4 years old was presented with severe lameness on the left front leg. The limping gradually progressed. After several radiographs and a biopsy, the dog was diagnosed with a fibrosarcoma at the lateral aspect of the left elbow. Because it was impossible to perform a wide excision and the tumour was prone to recur, it was decided to perform a limb amputation. Immediately postoperatively, incisional negative pressure wound therapy (NPWT) was applied, to minimize the risk of postoperative seroma formation. Surgical closure of the amputation site was routine and finalized with an intradermal suture. A Prevena dressing was adhered to the skin, overlying the incision line. The NPWT pump was set at -125mmHg for 3 days. The combination of amputation and NPWT resulted in a fast recovery in this patient. The wound healed nicely and no complications were observed.
SAMENVATTING

Een mannelijk, gecastreerde Duitse herder van 4 jaar oud werd aangeboden met erg manken op de linker voorpoot. Het manken verergerde geleidelijk. Op klinisch onderzoek werd ook een erge weke delenzwelling ter hoogte van de linker elleboog gevonden. Na verschillende radiografieën en diepe bioplen werd de hond gediagnosticeerd met een fibrosarcoma ter hoogte van het laterale aspect van de linker elleboog. Omdat een wijde excisie van de tumor onmogelijk was, werd er besloten om een pootamputatie uit te voeren.

Omdat de kans op seromavorming na lidmaatamputatie bij grote honden reëel is, werd de eigenaren voorgesteld om onmiddellijk postoperatief incisionele negatieve druktherapie (NDT) toe te passen. Hiervoor werd de wonde routinematig gesloten tot en met de intradermale hechting waarna een Prevena wondverband over de incisielijn werd gekleefd en de negatieve drukpomp op van -125mmHg werd ingesteld voor een behandeling gedurende 3 dagen.

Een seroma is een onderhuidse ruimte waarin serosanguineus vocht opstapelt. Dit kan zich ontwikkelen na een operatie ten gevolge van doorsijpen van serum en vocht doorheen capillairen. Om de vorming hiervan te verhinderen, is het gebruikelijk om postoperatief een drain te plaatsen om overtollig vocht af te laten en de huid meer contact te laten maken met de onderliggende weefsels. Een meer recente techniek omvat de NDT waarmee met behulp van een pomp een negatieve druk wordt gecreëerd in de wond. In de humane literatuur is beschreven dat incisionele NDT zorgt voor het verminderen van oedeem ter hoogte van de chirurgische wond, het voorkomen van seroma- of hematoomvorming, minder complicaties bij patiënten met comorbiditeiten. Daarenboven zou het postoperatieve wondinfecties en wonddehiscentie kunnen voorkomen. Één casusbespreking en een retrospectieve studie met betrekking tot de incisionele NDT werden gepubliceerd in de veterinaire literatuur. Hierin wordt vermeld dat er een verminderde zwelling wordt waargenomen en een lagere hoeveelheid vocht wordt gedraineerd na de toepassing van incisionele NDT. Er zijn meer studies nodig om te onderzoeken of de voordelen in diergeneeskundige patiënten vergelijkbaar zijn met deze in humane patiënten.

De combinatie van de amputatie en de NDT resulteerde in een snel herstel bij deze patiënt. De wond was goed geheeld en er werden geen complicaties waargenomen.

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1. INTRODUCTION

Negative pressure wound therapy (NPWT) is a wound treatment which includes a wound dressing placed onto the wound bed, an adhesive, airtight seal, a vacuum pump and a canister where extracted fluids can be captured (Howe, 2015; Perry et al., 2015). The pump can be programmed in a continuous or intermittent way and the standard pressure is -125 mmHg (Birke-Sorensen et al., 2011). In this way, a closed environment is created in which wound healing is promoted (Howe, 2015). In veterinary medicine, there is limited use of specialised NPWT systems (Nolff and Meyer-Lindenberg, 2016). Various pumps exist and the portable device, the V.A.C. Freedom (KCI, Texas, USA), is very convenient in animal patients for the device can be incorporated into a patient's harness (Pitt and Stanley, 2014).

The main mechanisms of NPWT involve removal of exudates, reduction of tissue oedema, increased perfusion, mechanical actions, and enhanced formation of granulation tissue (Howe, 2015; Nolff et al., 2015b). Indications of NPWT include various wounds such as chronic, acute, traumatic, subacute and dehisced wounds, skin grafts and flaps, partial-thickness burns and closed incisions (Howe, 2015). Several veterinary case reports and case series have been published involving open wound treatment (Ben-Amotz et al., 2007; Guille et al., 2007; Mullally et al., 2010), septic peritonitis (Buote and Havig, 2012; Cioffi et al., 2012) and skin grafts (Stanley et al., 2013). Only one case report (Nolff et al., 2015a) and one retrospective controlled clinical study (Perry et al., 2015) regarding incisional NPWT have been reported in veterinary literature.

The Prevena Incision Management System (Prevena Therapy, KCI USA, Inc, Texas, USA) is made especially for closed incisions immediate postoperatively and consists of a NPWT device and a Peel & Place Dressing, which includes a non-adhesive skin interface dressing, a silver-impregnated polyurethane foam and an airtight seal with a tube (Figure 1) (KCI Licensing, Inc., 2016a).

![Prevena Incision Management System](image)

**Figure 1.** The Prevena incision management system consists of A: silver-impregnated polyurethane foam; B: connector to attach the dressing to the NPWT device; C: a canister; D: NPWT device (from: KCI Licensing, Inc., 2016)

In this case report, the treatment of the surgical wound after amputation of the left forelimb in a large breed dog is described. Negative pressure wound therapy with Prevena was applied.
2. CASE

A male castrated German shepherd of 4 years old was presented at the Faculty of Veterinary Medicine of Ghent University in Merelbeke with severe lameness on the left front leg, especially after rest (Figure 2). Two years earlier, he slipped and acutely became lame on his left front leg. This lameness resolved after a treatment with non-steroidal anti-inflammatory drugs. Six months before presentation, the lameness returned and the local veterinarian restarted the anti-inflammatory drugs and performed an intra-articular injection with corticosteroids in the left elbow. The dog responded well and the lameness improved. However, 1 month before presentation at the faculty, the limping on the left front leg worsened again. It was especially present after rest and the owners had the impression that the lameness was progressing.

On clinical examination the dog appeared alert and expressed some aggressive behaviour, which complicated the examination. The orthopaedic inspection revealed left front leg non-bearing lameness. Severe swelling of the soft tissue at the lateral aspect of the left elbow was noticed and the range of motion of the left elbow joint was very compromised. The dog also expressed a lot of pain during flexion of this elbow.

Radiographs of the left elbow and the thorax had been taken by the local veterinarian 4 months before presentation and they were repeated at the faculty on presentation. The radiographs performed at the faculty showed a very irregular brush-like periosteal reaction at the caudolateral aspect of the distal humeral metaphysis, associated with a severe adjacent soft tissue swelling, which demonstrated amorphous mineralisation adjacent to the bone (Figure 3A). On the mediolateral projection (Figure 3B and 3C), there was a Codman's triangle, a triangular elevation of the periosteal reaction towards the diaphysis indicating a malignant lesion (Divya et al., 2009). On the medial aspect of the distal humerus, the periosteal reaction was smoother. There were no clear osteolytic areas visible, although the bone appeared more heterogeneous on the caudolateral aspect, presumably due to permeative lysis. The transitional zone of this lesion was large. The radiographic diagnosis of an aggressive monostotic bone lesion, possibly consistent with a primary bone tumour such as an osteosarcoma, was made, although the location and the age of the dog were not typical for this type of neoplasia. In addition to the previous findings, a focal medullary opacity of the proximal radius was detected, which could correspond with a bone infarct, typically associated with osteosarcoma. Biopsies of the humeral lesion were advised.

On the radiograph of the thorax, no abnormalities were seen. Unfortunately, only one lateral radiograph was taken.
Also, an ultrasound of the left elbow was performed to evaluate the affected area. It was decided to sedate the dog with butorphanol 0.3 mg/kg (Dolorex, Intervet International B.V.) due to uncooperative behaviour of the dog. The mass at the level of the elbow had a heterogeneous appearance and contained several mineralizations. The underlying bone had a very irregular appearance with new bone formation as well as osteolysis (Figure 4).

To further differentiate and specify the origin of the mass, a deep biopsy was taken. For this procedure, the dog had to be anaesthetized. The premedication consisted of dexmedetomidine 5 μg/kg (Dexdomitor, Orion Corporation), midazolam 0.2 mg/kg, and methadone 0.3 mg/kg (Comfortan, Eurovet Animal Health B.V.) The anaesthesia was induced by propofol 2.5 mg/kg to effect (PropoVet Multidose, Abbott Logistics B.V.). A punch biopsy of 7 mm was taken at the punctum maximum of the soft tissue swelling. After the procedure, the patient received acepromazine 0.05 mg/kg and buprenorphine 20 μg/kg (Vetergesic, Patheon UK Limited). The dog was sent home with painkillers.
while waiting for the results of the biopsies. This comprised cimicoxib 2 mg/kg (Cimalgex, Vétoquinol SA) and tramadol 1-4 mg/kg.

The histopathological examination of the biopsy confirmed a soft tissue tumour, namely a fibrosarcoma. Since no clean margins could be obtained and given the poor prognosis after local excision, it was advised to perform an amputation of the left front leg. The owners were informed about an ongoing study concerning Prevena (KCI USA), which is an incisional NPWT method. In consultation with the surgeon, they agreed to participate in the study.

The surgery was scheduled 2 weeks after the radiographs, ultrasound and biopsy. A pre-operative blood examination showed mild hypoalbuminemia and mild thrombocytopenia. The dog received the non-steroidal anti-inflammatory drug cimicoxib 2 mg/kg and was premedicated with dexmedetomidine 5 μg/kg and methadone IV 0.5-1 mg/kg. The anaesthesia was induced with propofol 2.5 mg/kg to effect and the patient received prophylactic cefazoline 20 mg/kg (Cefazoline Sandoz). Maintenance of the anaesthesia was achieved by inhalational anaesthetic isoflurane 1.5-2.5% (Isoflo, Abbott Logistics B.V.). During the operation, the dog received a CRI of fentanyl 5-10 μg/kg/h (Fentadon, Eurovet Animal Health B.V.) for proper analgesia.

The skin incision was made dorsally from the left scapula to the left shoulder joint and continued circularly from the shoulder to the triceps region on the lateral side as well as the medial side. Hemostasis was achieved by bipolar electrocoagulation. Then, the muscles attached to the scapula, namely the m. rhomboideus, m. serratus ventralis, m. latissimus dorsi and the m. pectoralis, were carefully dissected. The scapula was flipped cranially to identify the a. and v. axillaris and these vessels were ligated with polyglecaprone 3/0 (Monocryl, Ethicon) and transsected. The plexus brachialis nerves were infiltrated with bupivacaine 0.5 mg/kg (Marcaine 0.5%, AstraZeneca) and sharply transsected. The leg was removed by transsecting the remaining muscles.

The deeper muscle layers were closed with cruciate sutures (polydioxanone 0 (PDSII, Ethicon)) and the superficial muscle layers were apposed with a continuous suture pattern (polydioxanone 2/0). The deep layer of the subcutis was sutured to the underlying muscle fascia. The superficial layer of the subcutis was closed with a continuous pattern (polyglecaprone 3/0) and the skin was closed intradermally with polyglecaprone 3/0.

Immediately after the surgery, a Prevena dressing was placed (Figure 5). Blood was removed first with a sterile saline, the skin was dried, and then cleaned up from any organic tissue and fat with ether. The dressing package was opened in an aseptic way to keep the material sterile and the gauze was placed onto the closed incision in such a way that the adhesive drape surrounding it did
not come in contact with the incision. Then, the dressing was connected to a VAC-pump (KCI Animal Health) and programmed for a continuous negative pressure of -125 mmHg. Post-operatively, the dog received non-steroidal anti-inflammatory medication (cimicoxib 2 mg/kg) during 7 days and methadone IV 0.1-0.2 mg/kg for analgesia during 4 days.

On postoperative inspection, the patient seemed alert but nervous. The Prevena dressing was still present but the negative pressure was not maintained so the dressing needed to be changed and the NPWT was reapplied. The negative pressure was reinstalled quickly. The Glasgow pain score was followed up during 3 days in hospitalisation and methadone changed to tramadol 1-4 mg/kg based on a decrease in pain level observed after 3 days. The bandage was removed and the dog was discharged the day after. Automutilation had to be prevented and the patient should be kept at rest.

The patient was presented for a check-up 10 days after surgery. The dog walked well on 3 legs and was very excited. The medication was administered according to the advice of the surgeon and there was no need to continue the medication. The surgical wound looked dry, clean and not painful.

Five weeks after surgery (Figure 6), the dog was active and playful. The owner did not notice any pain or discomfort and is pleasantly surprised about the speed of recovery and the overall result. The surgical wound did nicely heal and hair was growing back in this area.

Figure 6. Five weeks after left forelimb amputation. The patient is doing very well on 3 legs and the surgical wound healed nicely.
3. DISCUSSION

Limb amputation is performed for various indications such as the impossibility of wide tumour excision, fractures, ischemic necrosis, osteomyelitis, soft tissue infection, unmanageable arthritis, paralysis, and congenital deformity. The decision to amputate depends on the preoperative condition of the patient, including the type of neoplasia, the expected capability of adapting to walk with 3 legs, and the owner (Raske et al., 2015). Contraindications involve severe osteoarthritis, obesity, and neurological problems. Postoperative complications include wound infection or inflammation, excessive blood loss, pain, and seroma formation. Wound inflammation and/or infection can be a consequence of the intensive surgical procedure, manipulation of soft tissues, or the position of the patient when laying down after surgery, which could exert unwanted tension on the surgical area. Usually, infection is superficial and can be controlled with antibiotics (Raske et al., 2015). Because amputation is an invasive surgery, excessive blood loss could also be an important complication and proper pain management should be applied for pain mediators could slow down the process of wound healing (Straw and Withrow, 1996; Widgerow and Kalaria, 2012). The patient in this case report received preoperative, intraoperative, and postoperative analgesia. Before surgery, the dog received NSAIDs and opioids. During the procedure, a CRI of fentanyl and a local anaesthetic were administered. Postoperatively, the patient acquired NSAIDs and opioids again.

After limb amputation, a dead space is present in which a seroma or a hematoma can be formed. A seroma is a space filled with serosanguineous fluid. The formation is due to postoperative inflammation with bleeding and leakage from capillaries (Amsellem, 2011; Kilpadi and Cunningham, 2011). Also, movement at the level of the surgical incision plays a role. Usually, conservative treatment is sufficient to gradually resolve the seroma. This comprises limitation of exercise and a warm compress or ultrasound for elimination of the fluid. Aspiration of the fluid is not advisable for it could lead to iatrogenic inoculation of bacteria, resulting in abscess formation. Hematomas are pockets in which blood accumulates and they can be formed due to incomplete hemostasis. Both phenomena exert tension on the surgical area and may lead to wound dehiscence (Amsellem, 2011). Furthermore, they may cause discomfort, delayed healing, and they can necessitate further surgical interventions (Kilpadi and Cunningham, 2011).

Commonly, to avoid postoperative seroma formation a drain is placed (Figure 7) (Kilpadi and Cunningham, 2011). Passive drainage by e.g. a Penrose needs gravidity to be efficient whereas an active drain will remove wound fluid due to suction exerted by an external container under negative pressure (Figure 7) (Balsa and Culp, 2015). A drain should exit the skin through a dedicated opening near the surgical incision; extra undermining should be avoided (Amsellem, 2011). The goal of placing a drain is to remove or prevent the formation of a dead space in order to let skin make contact with underlying tissues and to allow proper drainage of exudates which prevents the growth of bacteria and increases the accessibility of the immune system and medications. Also, the pressure under the surgical incision is lowered for better tissue perfusion and less pain. Furthermore, there will be drainage of inflammatory mediators, microorganisms, and foreign material which could have negative
effects on wound healing (Amsellem, 2011; Tobias and Johnston, 2013). One of the major complications of the placement of a drain is the risk of the development of a surgical site infection as it lowers the threshold for the number of microorganisms to induce infection and it is a foreign object which could encourage local inflammation (Eugster et al., 2004; Tobias and Johnston, 2013). In addition, passive drains might allow bacteria from the surroundings to mount into the wound alongside the drain surface (Balsa and Culp, 2015). Other problems related to drains include damage of vessels or tissue, metabolic problems due to excessive fluid loss, and pain induced by the tubing or by the exerted negative pressure in case of active drains (Tobias and Johnston, 2013).

A more recent approach to seroma prevention involves negative pressure wound therapy (NPWT). This technique was introduced in veterinary medicine for the treatment of traumatic wounds (Balsa and Culp, 2015). As the development of the technique progressed, more indications became suitable for this therapy. Nowadays, they include variable wounds, skin grafts and flaps, partial-thickness burns, and closed incisions (Howe, 2015). Mechanisms of NPWT for the improvement of wound healing involve removal of exudates, reduction of tissue oedema, increased perfusion, mechanical actions, enhanced formation of granulation tissue, reduced bacterial levels and decreased levels of pro-inflammatory cytokines and proteases (Howe, 2015; Nolff et al., 2015b). Closed incision management is one of the newest applications of NPWT. It is part of preventive medicine in which the goal is to lower the complication rate and therefore accelerate and optimise wound healing (Nolff and Meyer-Lindenberg, 2016).

In this case report, the Prevena Incision Management System (Prevena Therapy, KCI USA, Inc, Texas, USA) for closed incisions was applied postsurgically. The system consists of a NPWT device and a Peel & Place Dressing (Figure 8) (KCI Licensing, Inc., 2016a). The application of incisional NPWT has been proposed for high risk wounds in humans. Classifying wounds as ‘high risk’ can be related to 3 aspects: the type of trauma, lesions of the soft tissue or contusion, or patient factors (Stannard et al., 2012). These wounds are more likely to have complications postoperatively, for
example wounds after high velocity trauma, surgery of patients with certain underlying comorbidities like obesity, and median sternotomies. Also, wounds after an extensive and invasive surgery are considered high-risk. The postoperative complications involve wound necrosis, infection, swelling, and wound dehiscence (Stannard et al., 2012). These high risk wounds are also described in veterinary literature and are important indications for incisional NPWT (Perry et al., 2015; Nolff and Meyer-Lindenberg, 2016). Negative pressure wound therapy for closed incision management is mainly used to prevent complications postoperatively and not to treat already existing complications (Stannard et al., 2012). No specific contraindications regarding incisional NPWT exist, besides those that are described for standard NPWT (Stannard et al., 2012).

Therapy duration varies between 1 and 5 days but more studies are needed to clarify the guidelines regarding criteria to discontinue the incisional NPWT (Stannard et al., 2012). KCI recommends a Prevena therapy of a minimum of 2 days and a maximum of 7 days. The NPWT pump will pause by itself after 8 days of continuous therapy (KCI Licensing, Inc., 2016a). In this case report, the goal of the incisional NPWT was mainly to reduce or even prevent the risk of the occurrence of postoperative complications and specifically, seroma formation. The patient received 3 days of continuous NPWT. During hospitalisation, the system has to be checked regularly, since loss of negative pressure due to small leaks is a common technical issue in veterinary patients (Howe, 2015). During the predetermined treatment period, negative pressure should always be re-installed as soon as possible to avoid disturbance of the NPWT.

The beneficial effects of incisional NPWT described in human literature include a decrease of oedema, seroma and/or hematoma formation, and less complications in patients with comorbidities. Furthermore, incisional NPWT may prevent surgical site infections and wound dehiscence (Stannard et al., 2012; Horch, 2015; Suh et al., 2016). It is assumed that the compressive effect of NPWT and/or the minimal movement of the surgical area during NPWT led to avoidance of hematoma or seroma development (Suh et al., 2016). Consequently, as the occurrence of seroma formation is reduced, the risk of wound dehiscence is lowered (Amsellem, 2011; Suh et al., 2016). Moreover, incisional NPWT seems to reduce postoperative complications in patients with comorbidities such as vascular problems, diabetes, and obesity (Dohmen et al., 2014; Weir, 2014).

Surgical site infections are very common postoperatively. They are defined as infections at the level of the operative site after surgery. These could occur in the skin and subcutis (superficial surgical site infection) or could include the fascia and muscle layers (deep surgical site infection) (Kirby and Mazuski, 2009). Infections slow down the process of healing, which results in a weak area and the risk of wound dehiscence is high. Perioperative administration of cefazoline, a first generation cephalosporine, is recommended for the prevention of a surgical site infection when patients are less

Figure 8. Prevena Incision Management System for closed incisions (Care, 2011).
immunocompetent or when surgeries last longer than 90 minutes (Amsellem, 2011). The dog in this case report received cefazoline during induction of the anaesthesia. Prevention of surgical site infections has to take several risk factors into account, which involve patient-related factors, the surgical procedure itself, and the surgeon and assistants. In a study where pigs were used as animal models, a higher perfusion in the wounds was measured compared to wounds without application of incisional NPWT. It was hypothesized that a higher perfusion leads to more delivery of oxygen to the surgical site and could play a role in the prevention of infection and killing of bacteria due to a higher availability of superoxides (Suh et al., 2016).

Also, it is reported that 50% less tension is exerted on both sides of surgical incisions in NPWT compared to no NPWT. It is comparable to tension exerted on intact skin. In addition, a good apposition of the incisional edges is established (Wilkes et al., 2011). In pig models with artificially created dead spaces in the subcutis, researchers found less hematoma and seroma formation and better drainage of fluids after closed incision management with the Prevena incision dressing compared to a control group with a semipermeable dressing (Kilpadi and Cunningham, 2011). The positive effects described in veterinary research on incisional NPWT include reduced swelling and fluid drainage after surgery in patients treated with incisional NPWT versus control patients (Perry et al., 2015). In the only case report on incisional NPWT in a dog, wound healing was achieved with incisional NPWT after a period of postoperative problems regarding the surgical incision (Nolff et al., 2015a). The VAC Freedom was applied, which is a mobile device that can be incorporated into a dog’s harness (Pitt and Stanley, 2014; Nolff and Meyer-Lindenberg, 2016). There were no complications during and after incisional NPWT. The owner also noted that there were no signs of discomfort or changes in behaviour during the therapy (Nolff et al., 2015a). More studies are needed to examine whether the effects in veterinary medicine of incisional NPWT are similar compared to those described in human medicine.

Possible complications of incisional NPWT are bleeding, an allergic reaction to the material, infection, and a leak in the system. The therapy should be discontinued when these complications occur and a re-evaluation of the incision and the treatment should be performed (KCI Licensing, Inc., 2016b). Bleeding may occur when inadequate hemostasis is applied or a coagulation disorder is present. Also when the Prevena dressing is placed on exposed vasculature, it could potentially damage the vessels (Li and Yu, 2014). The risk for infection seems contradictory, as closed incision management with Prevena also appears to reduce the occurrence of infection. However, the foam and dressing used in NPWT may induce a foreign body reaction or may increase bacterial burden (Li and Yu, 2014). The Prevena dressing contains an acrylic adhesive coating and a layer with silver. This may induce an allergic reaction or could give skin irritation in a sensitive patient (KCI Licensing, Inc., 2016b). Fortunately, the patient described experienced no complications. The wound looked dry and clean and showed no signs of swelling or excessive fluid drainage. The patient was discharged after 3 days of NPWT. Already the day after the surgery, the dog walked well on 3 legs. The quick recovery was established due to a combination of proper analgesia, NPWT, and good health care.
Fibrosarcomas are classified as soft tissue sarcomas. Soft tissue sarcomas involve about 15% of all skin and subcutaneous tumours in dogs and they appear more frequently on the limbs (Liptak and Forrest, 2013; Bray, 2016). These tumours often occur in middle-aged to older dogs of medium to large-breed dogs. Soft tissue sarcomas express similar biological behaviour, which involves the occurrence at any location in the body, the tendency to form pseudo-encapsulated tumours with nonspecific histological margins, infiltration of fascia, the reappearance of the tumour after surgical excision, and the haematogenous spreading of metastases (Ehrhart, 2005; Liptak and Forrest, 2013; Bray et al., 2014).

The prognosis of soft tissue sarcomas depends on the histological grade, the size and depth of the tumour invasion. Metastasis is not common, unless there are repeated excisions because of tumour recurrence. To grade a soft tissue sarcoma, different histological characteristics are examined (Table 1). These include cellularity, the amount of differentiation, the extent to which normal tissue is invaded, the level of haemorrhage and necrosis, and the amount of mitotic figures per high power field (hpf) (Ehrhart, 2005). Eventually, the tumour in this case report had an intermediate grade (grade II) of malignancy. This means less than 50% of necrosis, the presence of specific characteristics of the original tissue, and 10-19 mitotic figures per hpf (Ehrhart, 2005).

**Table 1. Histological grading of soft tissue sarcomas (Ehrhart, 2005).**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Low grade (I)</th>
<th>Intermediate grade (II)</th>
<th>High grade (III)</th>
</tr>
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<tbody>
<tr>
<td>Necrosis</td>
<td>None</td>
<td>&lt;50%</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>Recognizable features</td>
<td>Yes</td>
<td>Yes</td>
<td>May not be present</td>
</tr>
<tr>
<td>of tissue of origin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitotic figures per hpf</td>
<td>0 – 9</td>
<td>10 – 19</td>
<td>&gt;20</td>
</tr>
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Treatment options for soft tissue sarcomas involve surgery, radiation therapy, and chemotherapy. Usually, surgery (wide excision) and radiation therapy are applied as a local treatment and chemotherapy to control and prevent metastasis (Ehrhart, 2005; Bray, 2016). In this case, it was decided to perform an amputation of the whole left front limb because it was impossible to obtain clean margins. The tumour made contact with the underlying bone, and consequently, the humerus had to be removed. The option to apply incisional NPWT on the surgical wound was suggested to the owners. The main goal of the NPWT was to decrease the risk of postoperative complications, such as seroma formation.

Applying NPWT on a surgical incision after limb amputation was successful in avoiding seroma formation in the dog described in this case report. More veterinary studies are needed to define specific veterinary guidelines, to clarify specific mechanisms of NPWT on incisions, and to study potential economical benefits.
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SURGICAL REMOVAL OF AN EXTRAMEDULLARY PLASMACYTOMA IN THE NASOPHARYNX OF A CAT

by

Mei Lin GO
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Promotor: Prof. Dr. Hilde de Rooster
Co-promotor: Sofie Marynissen, DVM

Case report
as part of the Master's Dissertation

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ABSTRACT

A male castrated Persian of 4 years old was presented with severe dyspnoea, open-mouth breathing, and an inspiratory stridor. After radiographs of the thorax, the main differential diagnosis was feline bronchial asthma. The cat was sent home on medication. However, 2 weeks after the start of the treatment, the cat was presented at the emergency service. Tachypnoea, dyspnoea, an inspiratory stridor, and open mouth breathing were present. After mouth inspection and CT of the head, there was a high suspicion of a left-sided nasopharyngeal polyp. Removal of the mass with the traction-avulsion technique through an oral approach was advised. During the surgery, however, the mass could not be removed by simple traction and needed excision. The left bulla tympanica was curetted. The mass was sent to an external laboratory and histopathological examination revealed an extramedullary plasmacytoma of the soft palate.

Treatment of a nasopharyngeal mass consists of a combination of medication and surgery. Two surgical methods are preferred, namely traction-avulsion and bulla osteotomy. The first is applied when the mass is solely located in the nasopharynx. Bulla osteotomy is indicated when the tympanic bulla is involved.

The prognosis of the patient in this case report is unclear for the presence of a plasmacytoma originating from the soft palate is rarely described in scientific literature.

Key words: Nasopharyngeal mass – Plasmacytoma – Traction-avulsion – Veterinary medicine – Cat
SAMENVATTING

Een mannelijk, gecastreerde Pers van 4 jaar oud werd aangeboden met erge dyspnee, open mond ademen en een inspiratoire stridor. Op klinisch onderzoek waren er versterkte longgeluiden aanwezig en de kat had een lichaamsconditiescore van 3/9. Na het beoordelen van radiografieën van de thorax, was de meest waarschijnlijke diagnose feliene bronchiale astma. Een medicamenteuze behandeling werd opgestart en de kat werd naar huis gestuurd. Na 2 weken werd de kat echter opnieuw aangeboden. De kat vertoonde tachypnee, dyspnee, een inspiratoire stridor en open-mond ademen. Op klinisch onderzoek werden opnieuw versterkte longgeluiden gehoord en deze keer werd een hartruis van 1/6 gevonden. Daarnaast was er sereuze uitloei uit de ogen.

Na het onder anesthesie brengen van de kat werd een mond- en keelinspectie uitgevoerd. Hierbij werd een harde, ronde, goed afgelijnde massa in de nasofarynx gevonden. Ook werd een fijne naald aspiratie genomen en dit liet necrotisch debris, gedegenererde neutrofielen en clusters van homogene epitheliaal cellen zien. Op de CT van de kop was een vergroting en deformatie van de linker bulla tympanica te zien. De wand was verdikt en er was een rostroventrale opening aanwezig. Beide bullae waren gevuld met een weke delen opaciteit. De voorlopige waarschijnlijkheidsdiagnose was een otitis media ten gevolge van een inflammatoire poliep die zich in de nasofarynx presenteerde.

Chirurgische verwijdering van de massa met behulp van de tractie-avulsie techniek werd aangeraden. Hierbij kwam purulent materiaal vrij en de massa bevatte geen steel in tegenstelling tot wat men wel verwachtte aan te treffen. De massa werd weggesneden en de linker bulla tympanica werd gecuretteerd. Histopathologisch onderzoek onthulde een dicht infiltraat van plasmacellen en neutrofielen wat kon duiden op een plasmacellulaire en neutrofiele inflammatie. De "Polymerase Chain Reaction Antigen Receptor Rearrangements" (PARR) test bevestigde uiteindelijk dat het een neoplastisch proces was, namelijk een extramedullair plasmacytoom van het zachte gehemelte.

Behandeling van een massa ter hoogte van de nasofarynx bestaat uit een medicamenteuze therapie voor het behandelen van een bestaande otitis en chirurgie om de massa te verwijderen. Er zijn twee chirurgische technieken aanbevolen om een massa uit de nasofarynx te verwijderen: tractie-avulsie en osteotomie van de bulla met een ventrale of een laterale benadering. De eerste methode is voornamelijk geïndiceerd bij een nasopharyngeale massa. Wanneer het middenoor is betrokken zal men voorkeur hebben voor een osteotomie van de bulla tympanica. Bij chirurgie ter hoogte van de bulla tympanica van de kat moet men rekening houden met de anatomie van zowel de benige als de neurovasculaire structuren. De bulla van de kat bestaat uit 2 compartimenten en het beschadigen van belangrijke neurovasculaire structuren kan erge complicaties tot gevolg hebben. Het is gebleken dat de ventrale benadering van de osteotomie van de bulla de meest succesvolle techniek is wat betreft de kans op het terugkeren van een inflammatoire poliep. Deze techniek heeft wel meer risico op complicaties ten opzichte van tractie-avulsie.

De prognose voor deze kat is onduidelijk doordat het voorkomen van een plasmacytoom uitgaande van het zachte gehemelte nog weinig is beschreven in de literatuur. Dit zal blijken bij verdere opvolging van deze patiënt.
1. INTRODUCTION

Symptoms such as dyspnoea, inspiratory stridor, and difficulty with swallowing are indicative for nasopharyngeal disease. The nasopharynx is delineated by the soft palate, the choanae, and the larynx. Diseases in this area can arise from any structure within its borders such as the soft and hard palate, the Eustachian tubes, and the mucosa (Hunt et al., 2002). This could involve a foreign body, neoplasia, inflammatory polyp, abscess, granuloma, extraluminal compression, and inflammation (i.e. rhinitis, laryngitis) (Gough, 2008; Tompson, 2013). A distinction between a single nasal disease and a nasopharyngeal disease can be made by the clinical presentation. The first is commonly presented with nasal discharge and sneezing and the second is often characterized by stertor, change of voice, dyspnoea, and open-mouth breathing (Allen et al., 1999). Stertor is a snoring sound which is produced due to an obstruction rostrally from the larynx. Cats may present with dyspnoea due to aversion to or incapacity of open-mouth breathing. Difficulty with swallowing may be caused by irritation of the pharynx (Hunt et al., 2002).

To differentiate between diseases, the start and evolution of the symptoms should be considered. Foreign bodies typically have an acute onset whereas slow-growing tumours and inflammatory polyps frequently have a more chronic development. Also, age is an indicator because polyps are more common in younger cats compared to neoplasia (Hunt et al., 2002).

Nasal tumours in cats are rare. They concern around 8% of all feline tumours and are frequently of epithelial origin (Meuten, 2016). In a study of 123 cases, the most common epithelial nasal tumours were adenocarcinomas and squamous cell carcinomas. The majority of epithelial tumours came from the pseudo-stratified respiratory epithelium of the nasal cavity. Non-epithelial tumours involved malignant lymphoma, fibrosarcoma, and plasmacytoma (Mukaratirwa et al., 2001). An important sign of neoplastic involvement is enlargement of regional lymph nodes such as the mandibular and retropharyngeal lymph nodes (Hunt et al., 2002).

A very common anomaly in this area in cats is the inflammatory polyp. These masses originate from the mucosa of the middle ear, Eustachian tube or the nasopharynx. Polyps may grow from the auditory tube into the nasopharynx which causes symptoms such as dysphagia and upper respiratory problems, or grow towards the middle ear and could cause symptoms of an otitis media or otitis interna like Horner syndrome and vestibular symptoms. When the origin lies in the middle ear and the polyp grows into the tympanic membrane signs such as otorrhea, head shaking and a visible mass in the external ear canal can be noticed (Tillson and Donnelly, 2004; Sula, 2012). Commonly, polyps are unilateral (Sula, 2012).

Nasopharyngeal diseases can be accompanied by secondary bacterial or fungal infections. In case of inflammatory polyps, it is unclear whether bacterial infection is primary or secondary (Tillson and Donnelly, 2004). Infection can be characterized by nasal discharge, rhinitis, and sinusitis (Fossum, 2013). Appropriate treatment with antibiotics is necessary (Tillson and Donnelly, 2004).

In this case report, a patient with chronic respiratory problems was presented and a nasopharyngeal mass was diagnosed after throat inspection and CT. Removal of the mass was performed and, after histopathologic evaluation, a plasmacytoma was diagnosed.
2. CASE

A male castrated Persian of 4 years old was presented to the Faculty of Veterinary Medicine of Ghent University with chronic dyspnoea. Since 2 months, the cat had trouble breathing and it seemed to gasp for air, especially during sleeping. According to the owner, the cat also lost 1 kg of body weight. The cat was not correctly dewormed. Due to these symptoms, the owners visited the local veterinarian 3 weeks before presentation to the faculty. The veterinarian administered an injection of corticosteroids and extracted 3 teeth. The symptoms improved partially afterwards. However, after 3 weeks, the owner presented this cat to the emergency service because the cat expressed severe dyspnoea and open-mouth breathing.

On clinical examination, inspiratory dyspnoea, and stridor were apparent. There was no nasal discharge. At lung auscultation, enhanced lung sounds with end-inspiratory wheezes were present. Sometimes, open-mouth breathing was seen. The cat had a body condition score of 3/9. Blood examination revealed a mild to moderate non-regenerative anaemia. Thoracic radiographs were taken and showed a diffuse bronchial lung pattern characterized by multiple donuts and tramlines in the entire lung field (Figure 1A); the changes were more pronounced caudally. Moreover, an undulating, tenting appearance of the diaphragm was seen (Figure 1B). Furthermore, there was a suspicion of hepatomegaly. The main differential diagnosis based on the clinical presentation and the radiographs was feline bronchial asthma. Because the patient was an indoor cat, an infectious cause was less likely. The cat was send home on prednisolone 1-2 mg/kg/day (Prednisolone 5 mg Kela, Kela Laboratoria): 1 tablet twice daily for 1 week, ¾ tablet twice daily for 2 weeks, and ½ tablet twice daily for 2 weeks. Also, the patient received deworming with imidacloprid 10 mg/kg and moxidectin 1 mg/kg (Advantage multi for cats, Bayer). In case of an asthma crisis, salbutamol 100 μg/dosis (Ventolin, Glaxo Wellcome SA) was advised.

Figure 1. A: Left-lateral view of the thorax. A diffuse bronchial lung pattern was present with donuts and tramlines (red arrows), and the liver showed rounded edges (blue arrow); B: Ventrodorsal view of the thorax. The diaphragm showed an undulating, tenting appearance (green arrows).
Two weeks after the start of the treatment, the cat was represented at the emergency service. The treatment did not give improvement. He showed tachypnoea and dyspnoea and according to the owner, he was remarkably calm. The cat only ate when it was offered by hand and drinking was very difficult. The owners also reported a snoring sound. The medication was given as prescribed, including the deworming product.

On clinical examination, an inspiratory stridor, open-mouth breathing, and occasionally, mild inspiratory dyspnoea were found. At lung auscultation, wheezes were heard and heart auscultation revealed bradycardia and a systolic heart murmur of 1/6. Also, there was some serous fluid draining from the eyes. It was decided to hospitalize the patient for further investigation and monitoring.

A mouth inspection and a CT-scan of the head were scheduled because an inspiratory stridor and inspiratory dyspnoea were present. These symptoms indicated an upper respiratory tract disease instead of a bronchial disease such as asthma, which was previously diagnosed at the first presentation. Though, a mixed problem, i.e. upper respiratory tract polyp combined with asthma, was not excluded. Premedication consisted of methadone 0.2 mg/kg (Comfortan, Eurovet Animal Health B.V.) and midazolam 0.2 mg/kg (Dormicum, Roche). The anaesthesia was induced with alfaxalone 5 mg/kg (Alfaxan, Vetoquinol SA) and maintained by isoflurane 1.5-2.5% (Isoflo, Abbott Logistics B.V.).

During the mouth inspection, at the level of the nasopharynx, a hard, round, and nicely delineated mass was found. The retropharyngeal inspection showed that the mass entirely filled the nasopharynx and no stalk was identified. During this examination, fine needle aspirations (FNAs) were taken. Cytological examination of the FNAs revealed necrotic debris, many degenerated neutrophils, and some clusters of homogenous looking epithelial cells without malignant characteristics. The CT images showed severe enlargement and deformation of the left tympanic bulla (Figure 2 and 3). The wall of the bulla was severely thickened and hyperostotic and rostroventrally, an opening with a diameter of 3.4 cm was visible. The bulla extended ventrally over the midline into the region of the nasopharynx. Both bullae were filled with a fluid or soft tissue opacity and the soft tissue opacity in the left bulla extended into the nasopharynx. A moderate amount of destruction of the nasal turbinaliae and conchae was seen. Moreover, mildly enlarged retropharyngeal and mandibular lymph nodes were visible as well as herniation of the cerebellum in the foramen magnum. Contrast images were made (Figure 2B). These showed heterogeneous contrast uptake in both bullae. At the left side of the nasopharynx, a mass with rim enhancement was visible. The tentative diagnosis of otitis media due to an inflammatory polyp extending from the bullae in the nasopharynx was made.
There is a severe enlargement and deformation of the left tympanic bulla with rim enhancement (red arrow) and a soft tissue opacity within the bulla.

Surgical removal of the mass was advised. The cat received methadone 0.2 mg/kg and the anaesthesia was induced by propofol 8 mg/kg (PropoVet Multidose, Abbott Logistics B.V.). Maintenance of the anaesthesia was achieved by isoflurane 1.5-2.5%. During the operation, a fentanyl CRI of 5-10 μg/kg/h (Fentadon, Eurovet Animal Health B.V.) was given for proper analgesia.

Stay sutures in poliglecaprone 25 (Monocryl, Ethicon) were placed to allow cranial traction on the caudal border of the soft palate. The mass was bluntly dissected from the surrounding tissue, to which it was firmly attached (Figure 4). Purulent material was released during dissection; a swab was taken for bacteriological examination. The remaining abnormal tissue was firmly attached to the surroundings and the typical stalk, present in case of an inflammatory polyp, was not present. After the purulent material was removed, the opening in the bulla wall became visible; it was large enough to
allow curettage of the tympanic cavity. The middle ear was flushed with warm sterile saline (Vetivex Ringer lactate, Dechra) until clear fluid was retrieved (Figure 5).

![Figure 4. The mass was removed after cranial traction of the soft palate.](image)

![Figure 5. After removal of the mass, the tympanic bulla was flushed extensively.](image)

Postoperatively, an injection of dexamethasone 0.1 mg/kg (Rapidexon, Eurovet Animal Health B.V.) was given to reduce swelling. A reduction schedule of prednisolone was initiated which involved 1 to 2 mg/kg/d for 2 weeks, 0.5 - 1 mg/kg/d for 7 days and then 0.5 mg/kg every 2 days for 10 days. In addition, enrofloxacine 5 mg/kg (Baytril flavour, Bayer B.V.) was prescribed for 7 days without awaiting the bacteriology results. Giving theofylline 4 mg/kg twice a day was advised for 2 weeks.

Bacteriology of the purulent material revealed numerous colonies of *Pasteurella multocida*, which are usually sensitive to enrofloxacine. Therefore, the antibiotic treatment was continued for 3 weeks. Eleven days after surgery, the cat was doing very well and did not express stridor or dyspnoea anymore.

Histopathological examination showed a dense infiltrate of plasma cells and neutrophils associated with fibrosis, edema, and centrally, numerous zones of foamy macrophages, representing a
plasmacellular and neutrophilic inflammatory reaction. A Polymerase Chain Reaction (PCR) for an Antigen Receptor Rearrangements (PARR) test was necessary to determine whether the observed changes were inflammatory or neoplastic. The test revealed clonal rearrangements of immunoglobulins. The definitive histopathological diagnosis was a plasmacytoma.

Five weeks after surgery, the owner of the cat noticed a mild gurgling sound and it was decided to stop the prednisolone. When there were no severe complaints, the owner was advised to return for a check-up within 3 months. Sixteen weeks postoperative, the patient was doing very well and the owner did not revisit a veterinarian. The only unusual finding of the owner was that the cat raises the head in sternal decubitus. No abnormal breathing sounds were present and no complications occurred.
3. DISCUSSION

Feline patients presented with chronic dyspnoea, inspiratory stridor or stertor, and open-mouth breathing, such as in this case report, are suspected of nasopharyngeal disease. Especially stertor is characteristic for an anomaly in the nasopharynx. It is a snoring sound caused by an obstruction rostral to the larynx (Allen et al., 1999; Hunt et al., 2002). Nasal discharge and sneezing are not always present in nasopharyngeal disease, depending on the etiology. Absence of nasal discharge is usually due to swallowing of the accumulated material (Hunt et al., 2002).

The main differential diagnoses of a mass in the feline nasopharyngeal area involve a nasopharyngeal polyp, neoplasia, foreign body, granuloma, and an abscess (Gough, 2008; Tompson, 2013). Nasopharyngeal polyps are benign, inflammatory, stalked masses which can occur in the oropharynx, middle ear, or external ear canal. It is assumed that they arise from the epithelium of the nasopharynx, the tympanic bulla or Eustachian tubes (Oliveira et al., 2012). When the mass grows, it can migrate through the Eustachian tube into the nasopharynx and causes dysphagia and upper respiratory symptoms or it grows towards the tympanic membrane into the middle ear and may cause signs of otitis media or interna such as Horner syndrome and vestibular problems. When a polyp develops towards the external ear canal, symptoms such as dark otorrhea, head shaking, and a visible mass in the external ear canal can be noticed (Sula, 2012; Fossum, 2013). Polyps are very common in cats; however, their cause is unknown. The development could be due to an inflammation such as a chronic respiratory infection, chronic otitis media, an ascending infection from the nasopharynx, or it could have a congenital basis (Kudnig, 2002; Tillson and Donnelly, 2004). Due to the high prevalence at a young age in cats, it is hypothesized that polyps are remainders of the branchial arches. Considering clinical symptoms and histopathological research, polyps may develop when inflammation is present. However, it is unclear whether infection and inflammation is primary or secondary to the disease (Tillson and Donnelly, 2004).

A neoplasia in the nasopharyngeal region is often characterized by the enlargement of the mandibular and retropharyngeal lymph nodes. Furthermore, chronic symptoms are present and it is more common in middle-aged to older cats (Hunt et al., 2002). These neoplasias can be classified into epithelial tumours such as adenocarcinomas and squamous cell carcinomas and non-epithelial tumours like malignant lymphoma and plasmacytoma (Mukaratirwa et al., 2001).

In this case report, there was a high suspicion of a nasopharyngeal polyp. However, during surgery, this suspicion was questioned because the mass did not have a characteristic stalk. Histopathological examination revealed a plasmacellular and neutrophilic inflammatory reaction and the Polymerase Chain Reaction (PCR) for an Antigen Receptor Rearrangements (PARR) test resulted in the definitive histopathological diagnosis: a plasmacytoma.

A plasmacytoma involves the neoplastic development of plasma cells (Sula, 2012). It can be classified in the group of myeloma-related disorders. This group consists of multiple myeloma, cutaneous extramedullary plasmacytoma, non-cutaneous extramedullary plasmacytoma, solitary plasmacytoma of bone, IgM macroglobulinaemia, immunoglobulin-secreting lymphoma, immunoglobulin-secreting...
leukaemia, and plasma cell leukaemia (Mellor et al., 2006). Less than 1% of tumours in dogs and even less in cats are plasma cell tumours (Weber and Tebeau, 1998). In this case report, an extramedullary plasmacytoma of the soft palate was diagnosed. In most cases, it presents itself as a cutaneous tumour (Majzoub et al., 2003; Lecouteur and Withrow, 2007a), which is frequently present as a single, well-demarcated mass and grows very quickly (Sula, 2012). Non-cutaneous plasmacytomas act more aggressively and metastasize to regional lymph nodes (Radhakrishnan et al., 2004). It is mainly seen in middle-aged cats (average 8-9 years) (Schöniger et al., 2007). The number of case reports about extramedullary plasmacytomas in cats are limited and include plasmacytomas of the skin (Kyriazidou et al., 1989; Breuer et al., 1993; Majzoub et al., 2003), in the sinonasal area (Schöniger et al., 2007; Sykes et al., 2016), the oral cavity (Majzoub et al., 2003), gastric mucosa (Zikes et al., 1998), retroperitoneal (Mandel and Esplin, 1994), the eye region (Ward et al., 1997; Michau et al., 2003), liver (Larsen and Carpenter, 1994), and cerebrum (Greenberg et al., 2004). One case report described the evolution of a solitary cutaneous plasmacytoma into multiple myeloma in a cat (Radhakrishnan et al., 2004).

Diagnosis of a mass in the feline nasopharyngeal area can be made by the clinical presentation, history, clinical examination, biopsy, and medical imaging. To locate the problem, there should be a differentiation between stertor (nasal or nasopharyngeal location) and stridor (laryngeal or tracheal location) (Hunt et al., 2002). On otoscopic examination, a polyp may be seen as a ceruminous mass with a red, pink, or white colour and blood and/or mucus can be present. Also, the tympanic membrane can be affected by the mass and may be damaged. Sometimes, secondary infection can be present as a sinusitis or rhinitis with nasal discharge. Mouth inspection under anaesthesia with dental mirrors and spay hooks is important in order to try to visualize the mass and to evaluate the soft palate (Fossum, 2013). With palpation, nasopharyngeal masses and enlarged lymph nodes can be detected (Hunt et al., 2002). In the patient of this case report, a hard, round mass was found in the soft palate and retropharyngeal inspection showed extension throughout the entire nasopharynx. Fine needle aspirates were taken from the soft palate and this revealed necrotic debris with degenerated macrophages and clusters of homogeneous epithelial cells without malignant characteristics. These cytologic findings could refer to a polyp which usually shows stratified squamous to pseudostratified ciliated columnar epithelium, fibrovascular connective tissue with lymphocytes, plasma cells and macrophages (Muilenburg and Fry, 2002).

A flexible retroflexed endoscope may be used for better visualisation of the nasopharyngeal area, the oropharynx, the opening of the Eustachian tubes, and caudal nasal cavities in a retrograde way (Hunt et al., 2002; Muilenburg and Fry, 2002). When a mass is revealed during the examination, a tissue biopsy should be taken.

Medical imaging techniques involve radiographs and computed tomography (CT). A mass in the nasopharyngeal area can be seen in the majority of cases on a skull radiograph. Radiographic signs include a soft tissue opacity in the nasopharynx. CT is very helpful to see the exact location of the mass, if it is unilateral or bilateral, and how the mass grows (Fossum, 2013). Moreover, the external
ear canal, the tympanic membrane, osseous bulla, and the nasopharynx can be evaluated in a more detailed way (Oliveira et al., 2012). In this case, both bullae were filled with a soft tissue opacity and the opacity of the left tympanic bulla extended into the nasopharynx. Also, the nasal cavities contained soft tissue opacities and on the left side some destruction of the turbinale and conchae was present. Changes of the tympanic bulla may occur due to chronic inflammatory reactions. These changes involve thickening of the wall and expansion of the bulla (Muilenburg and Fry, 2002; Lamb et al., 2016). The CT image of this case showed severely enlarged and deformed left tympanic bulla with a thickened and hyperostotic wall indicating a chronic process. Rim enhancement on post-contrast CT images seems to relate to the amount of inflammation present in the stromal layer of a polyp (Oliveira et al., 2012; Lamb et al., 2016). The rim enhancement on the CT images of this case and the severe deformation of the left tympanic bulla was probably due to the secondary inflammatory reaction. Moreover, it is likely that the rostroventral opening in the bulla was caused by external pressure and inflammation because inside the bulla, only some purulent material was present and no severely inflamed tissue that could cause bone deformation and lysis. Besides rim enhancement, other distinguishing factors between polyps and other processes include a stalk-like structure in case of a polyp and an extension of the mass into other regions of the skull and border effacement of the bulla and adjacent structures when there is a neoplastic process (Oliveira et al., 2012). A typical stalk-like structure was not found on the CT image of the patient of this case. In addition, due to the extension of the soft tissue opacity from the bulla into the nasopharynx neoplasia was not excluded.

Medical treatment post-operatively in the patient of this case report was based on the high suspicion for an inflammatory nasopharyngeal polyp and bacteriologic examination. Therapy with only medication of such a polyp has proven to be inadequate and could only help as an adjuvant therapy to surgery (Tillson and Donnelly, 2004). In this case, bacteriologic examination of a sample from the mass revealed numerous colonies of *Pasteurella multocida*. Thus, an infection was present and because the tympanic bulla was involved, it was diagnosed as an otitis media. It could be the cause of the suspected polyp as it is hypothesized that polyps could be induced by chronic inflammation (Kudnig, 2002; Kennis, 2013). The choice of antibiotics should be based on an antibiogram and susceptibility test to determine the minimal inhibitory concentration (MIC) to reach the middle ear in a systemic way (Gotthelf, 2004). Probably because the patient already received enrofloxacine 5 mg/kg once daily, growth was too slow for an antibiogram. It was decided to proceed with the same antibiotics postoperatively.

The most successful treatment is surgical removal of the mass. This has shown to have the least chance of coming back in case of nasopharyngeal polyps (Tillson and Donnelly, 2004). The removal of the mass can be performed by traction-avulsion, ventral bulla osteotomy, myringotomy, lateral ear resection, and ear canal ablation with lateral bulla osteotomy (Lanz and Wood, 2004; Tillson and Donnelly, 2004). The choice of surgical method depends on the location of the mass, the extent to which the middle ear is affected, and the preference of the surgeon (Muilenburg and Fry, 2002). The most common and successful method is the ventral bulla osteotomy (Tillson and Donnelly, 2004). In this case report, there was a high suspicion of a nasopharyngeal polyp that was expanding towards
the tympanic bulla. Two approaches are preferable in such a situation: traction-avulsion and bulla osteotomy. Traction-avulsion can be performed when a polyp or other mass is present in the external ear canal or the nasopharynx. Initially, the soft palate should be held aside with stay sutures or a spay hook. It can also be incised for better visualisation. Then, the mass can be grabbed with a forceps and a mild tension is exerted while pulling it from its location (Muilenburg and Fry, 2002; Tillson and Donnelly, 2004).

When applying bulla osteotomy, the anatomy of the feline tympanic bulla and its adjacent neurovascular structures should be taken into account. The feline tympanic bulla consists of 2 compartments: a dorsolateral part, which is connected to the tympanic membrane and auditory ossicles and a ventromedial part, which includes the round window (Figure 6). Furthermore, the promontory should be identified because the sympathetic nerves are located next to this bone structure. Other significant structures in this area involve the internal carotid artery, nervus facialis, nervus hypoglossus, and the lingual artery and vein (Figure 7) (Lanz and Wood, 2004).

Figure 6. The tympanic bullae of a cat. These are organized into 2 compartments, namely a dorsolateral compartment (1) and a ventromedial compartment (2) (Tillson and Donnelly, 2004).

Figure 7. The vasculature and nerves in the region of the tympanic bulla of the cat (Paterson and Tobias, 2012).
The bulla osteotomy can be performed by a lateral and a ventral approach. With lateral bulla osteotomy, processes in the external, middle and inner ear regions can be reached. When a mass is found in the middle and inner ear, a ventral bulla osteotomy is indicated (Muilenburg and Fry, 2002). Starting a ventral bulla osteotomy involves making a paramedian incision cranial to caudal over the tympanic bulla. The nervus hypoglossus and the lingual artery are pulled medially and further dissection is performed medial to the musculus digastricus (Muilenburg and Fry, 2002; Lanz and Wood, 2004). The nervus facialis and the carotid artery are located laterally and medially from the bulla, respectively. Damaging these structures should be avoided (Muilenburg and Fry, 2002). After opening of the osseous bulla with a Steinmann pin or a neurosurgical air drill (Muilenburg and Fry, 2002), samples of the content can be taken and the tissue can be removed by traction and curettage. Flushing with sterile saline is needed to extract debris and the epithelium. Before closing the surgical wound, a passive or active drain is applied (Lanz and Wood, 2004).

Comparing the ventral bulla osteotomy and the traction-avulsion method (Table 1), the first needs experience and it is a time consuming and expensive procedure (Anderson et al., 2000). However, the rate of regrowth of nasopharyngeal polyps after surgical removal is much lower (0-8%) compared to traction-avulsion (33%) (Kudnig, 2002; Veir et al., 2002). It has to be taken into account that the higher recurrence rate of traction-avulsion may be due to contingent bulla involvement in certain cases and frequently, parts of a polyp are left behind. When the middle ear is involved, a ventral bulla osteotomy should be performed (Anderson et al., 2000; Veir et al., 2002). Traction-avulsion is a relatively simple technique and is therefore a faster and cheaper method. There is also a lower risk for complications for it is less invasive (Anderson et al., 2000; Veir et al., 2002).

The patient in this case report had a mass located in the nasopharynx and therefore, it was advised to apply the traction-avulsion technique. During surgery, it became clear that traction alone was not sufficient and excision was needed. Curettage and flushing of the nasopharynx and the tympanic bulla were applied to clear the area from purulent material.

Postoperatively, the patient should be monitored for recurrent dyspnoea because of possible formation of edema (Lanz and Wood, 2004). The use of prednisolone after removal of a nasopharyngeal polyp seems to lower the incidence of recurrence. A retrospective study in 37 cats showed no return of the polyp after traction with postoperative prednisolone and 64% of the cats without this treatment presented recurrence (Anderson et al., 2000). It can also be provided to decrease postoperative edema (Kudnig, 2002). Furthermore, analgesics before and after surgery are recommended (Muilenburg and Fry, 2002). In the cat of this case report, no recurrence of upper respiratory

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<th>Traction-avulsion</th>
<th>Ventral bulla osteotomy</th>
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<td>Relatively simple</td>
<td>Experience needed</td>
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<td>Fast</td>
<td>Time consuming</td>
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<td>Cheap</td>
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<td>Lower risk for complications</td>
<td>Higher risk for complications</td>
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<td>Recurrence rate of polyps 33%</td>
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Table 1. Comparison of the traction-avulsion technique and ventral bulla osteotomy.
symptoms was present and prednisolone was proceeded. Though, it was still uncertain whether the mass was a nasopharyngeal polyp.

Complications can be neurological or non-neurological. Neurological problems due to the surgery involve Horner’s syndrome, facial nerve paralysis, hypoglossal nerve deficits, persistent nystagmus, head tilt, and ataxia (Lanz and Wood, 2004). Horner’s syndrome is presented with enophthalmus, miosis, ptosis, and protrusion of the third eyelid. As a complication, it is caused by damaging the oculosympathetic trunk, which goes through the tympanic cavity, by removing the mass and curettage of the area (Tillson and Donnelly, 2004). Frequently, it regresses spontaneously after weeks to months. Though, the owner should be informed about an irreversible situation (Muilenburg and Fry, 2002). Facial nerve paralysis rarely occurs (Muilenburg and Fry, 2002). It is characterized by not being able to close the eyelid and the patient is unable to move the lips and ears (Van Goethem et al., 2010). This complication could be transitory as well (Muilenburg and Fry, 2002; Fan and de Lorimier, 2004). Damaging the hypoglossal nerve results in problems with swallowing, grabbing, and chewing. This can be avoided by a cautious surgical approach (Muilenburg and Fry, 2002). Neurological symptoms such as head tilt, ataxia, and nystagmus can be caused by excessive curettage (Tillson and Donnelly, 2004) and may be associated with otitis media and interna. This inflammation commonly occurs when the middle ear is involved unlike situations in which solely the (naso)pharynx is affected (Muilenburg and Fry, 2002).

Non-neurological complications could include the recurrence of the mass, an otitis media or interna, pharyngeal swelling, and fluid drainage from the surgical incision (Lanz and Wood, 2004). Returning of the mass is a very common complication, especially after traction-avulsion. This occurs in approximately in 33% of the cases (Muilenburg and Fry, 2002; Veir et al., 2002). Fortunately, there were no postoperative complications present in the patient of this case report. The otitis media was present preoperatively and treatment was already initiated and continued after surgery.

Cytology and histopathology are necessary to determine the origin of the mass and to differentiate between benign and malignant masses (Sula, 2012). In this patient, the Polymerase Chain Reaction (PCR) for an Antigen Receptor Rearrangements (PARR) test showed clonal rearrangements of immunoglobulins and the definitive histopathological diagnosis was a plasmacytoma. It could be classified as a non-cutaneous extramedullary plasmacytoma of the soft palate. Extramedullary plasmacytomas in cats can be histologically classified into hyaline, mature, cleaved, asynchronous, and polymorphous/blastic types (Platz et al., 1999; Cangul et al., 2002; Majzoub et al., 2003). The hyaline type is characterized by cells with eccentric sickle-shaped nuclei (Figure 8A). A mature type involves mature plasma cells with a characteristic 'cartwheel' aspect due to clumping of chromatin (Figure 8B). Cleaved forms of a plasmacytoma have cells with cleaved nuclei and a perinuclear halo (Figure 8C) (Platz et al., 1999). Asynchrony in the maturation of the nucleus and the cytoplasm can be found in asynchronous types. Also many giant cells, nuclei with a central nucleolus and clear perinuclear halo, and vacuolar cytoplasm are present (Figure 8D). Polymorphous or blastic types are
characterized by anisocytosis, polymorphous cells, and giant cells with vacuolar cytoplasm (Figure 8E) (Majzoub et al., 2003). Plasmacytomas typically produce a lot of immunoglobulins of a homogeneous type. This can be evaluated by immunohistochemical staining and gamma electrophoresis (Michau et al., 2003). In this case report, there were numerous plasma cells, some neutrophils, and there was a remarkable number of foamy cells. The latter was negative for the immunostain pan-cytokeratin, which is typical in epithelial cells and also in epithelial tumours (PathologyOutlines.com, 2017). The foamy aspect could be associated with vacuolar cytoplasm, which could correspond to an asynchronous type or a polymorphous type.

Figure 8. Different histological types of plasmacytomas. A: Hyaline type with eccentric sickle-shaped nuclei (red arrow); B: Mature types shows mature plasma cells with round to oval nuclei which show clumped chromatin (blue arrow); C: Cleaved type with cleaved nuclei (green arrow), anisocytosis and unusual perinuclear halos; D: Asynchronous types show asynchrony in the maturation of the nucleus and the cytoplasm and nuclei with a central nucleolus and a clear perinuclear halo (purple arrow); E: Polymorphous-blastic type is characterized by giant cells with multiple polymorphous nuclei (orange arrow) (Platz et al., 1999).

Because this case concerned a neoplasia, the application of chemotherapy should be considered. Indications of chemotherapy involve sensitivity of the tumour to chemotherapy, an adjuvant therapy to destroy existing micrometastasis or prevent recurrence, downstaging of a neoplasia for definitive treatment, sensitizing tissues for radiation therapy, and palliative treatment. The aim of the therapy is to manage the disease and to keep quality of life (Lecouteur and Withrow, 2007b). Melphalan is an alkylating drug which is cell cycle phase nonspecific. Alkylating agents change DNA-structure and therefore, suppress synthesis of DNA, RNA, and proteins (Lecouteur and Withrow, 2007b). Melphalan is indicated for multiple myeloma, extramedullary plasmacytoma, and anal sac adenocarcinoma (Zikes et al., 1998; Lecouteur and Withrow, 2007b). The goal of the treatment after surgical removal is to destroy remaining neoplastic tissue, prevent recurrence, and to avoid progression to a systemic
myeloma-related disease (Radhakrishnan et al., 2004; Lecouteur and Withrow, 2007b; Cannon et al., 2015). The starting dose is 0.07-0.1 mg/kg once daily for 10 days and then 0.07 mg/kg every other day. It is commonly combined with prednisolone 1-2 mg/kg/day to raise effectiveness of melphalan (Michau et al., 2003; Lecouteur and Withrow, 2007b). Prednisolone interferes with RNA production in the nucleus. Though, the precise effect is unknown (Weber and Tebeau, 1998). Possible side effects include myelosuppression and thrombocytopenia, which can be checked by a cell blood count every week in the starting phase and later every 4-8 weeks (Lecouteur and Withrow, 2007b). It is advised to provide antibiotic treatment in the initial phase to treat or avoid secondary bacterial infections (Weber and Tebeau, 1998).

Prognosis of an extramedullary plasmacytoma originating from the soft palate is unclear in cats because it has rarely been described. Two case reports described an extramedullary plasmacytoma in the feline nasal and nasopharyngeal area respectively (Schöniger et al., 2007; Sykes et al., 2016). One of these was also located in the soft palate and metastasized to regional lymph nodes (Sykes et al., 2016). Unlike in this case report, both patients were euthanized and were examined post mortem. When the tumour is limited to a single location, the disease can be managed with surgery and chemotherapy for a long time (Lecouteur and Withrow, 2007b). However, the progression to multiple myeloma in cats has been described (Radhakrishnan et al., 2004). There is little information about the effect of adjuvant chemotherapy on oropharyngeal plasmacytomas and due to possible side effects, it was decided to monitor the patient of this case based on clinical presentation and CT images. There was no initiation of chemotherapy. An otitis media was present as well. The prognosis is good when treated early and with the appropriate antibiotic such as in this case. However when treated inadequately, it may progress to an otitis interna which could result in vestibular symptoms (Shell, 1988). Sixteen weeks after surgery, the cat was still doing very well and did not receive medication since 2 months.

In conclusion, the mass in the nasopharynx of the patient described in this case report was highly suspected of a nasopharyngeal polyp. However, the surgical approach and further diagnostics (histopahology, PARR) revealed a non-cutaneous extramedullary plasmacytoma.
4. REFERENCES


