

## Ultrasonographic findings associated with uterine migrating grass seeds in eleven dogs

*Echografische bevindingen geassocieerd met uteriene migrerende grasaren bij elf honden*

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### ABSTRACT

Numerous locations have been reported for vegetal foreign body migration. However, urogenital migration has rarely been documented. In this retrospective study, the ultrasonographic features associated with intrauterine migrating vegetal foreign bodies (grass seeds) are described in one intact and ten ovariectomized bitches. The most common ultrasonographic finding was focal and mild ampullary dilation of the uterus, containing the foreign body outlined by scant intraluminal fluid. There were no changes seen to the uterine wall, except in one dog with uterine perforation, confirmed at surgery. The remainder of the uterus had a normal appearance in 8/11 dogs, while there was a small amount of intraluminal fluid in 2/11 cases. Mild, focal steatitis around the focal dilation of the uterus segment containing the foreign body was observed in one case. The subtlety of these findings suggests that the ultrasonographic diagnosis of uterine grass awns can be challenging. This underlines a discrepancy with other reported migration sites commonly associated with marked inflammation.

### SAMENVATTING

Talrijke locaties werden reeds beschreven wat betreft migratie van plantaardige vreemde voorwerpen, maar urogenitale migratie werd echter zelden gerapporteerd. In deze retrospectieve studie worden de echografische kenmerken geassocieerd met migrerende intra-uteriene vreemde voorwerpen van plantaardige oorsprong (grasaren) beschreven bij elf teven, waarvan tien gesteriliseerd en één intact. De meest voorkomende echografische bevinding bleek focale en milde ampullaire verwijding van de uterus die het vreemd voorwerp bevatte omringd door een kleine hoeveelheid lumaal vocht. Er werden geen abnormaliteiten van de uteruswand gezien. Behalve bij één hond met uteriene perforatie werd de abnormaliteit tijdens chirurgie vastgesteld. De overige delen van de uterus hadden een normaal uitzicht bij 8/11 honden, terwijl bij 2/11 gevallen een kleine hoeveelheid lumaal vloeistof werd vastgesteld. Bij drie honden werd milde, focale steatitis waargenomen rondom het vreemd voorwerp. De subtiele echografische bevindingen tonen aan dat de diagnose van een grasaar in de uterus een grote uitdaging kan zijn. Dit in groot contrast met andere beschreven locaties van migratie waarbij meestal zeer duidelijke tekenen van inflammatie worden vastgesteld.

### INTRODUCTION

Migrating vegetal foreign bodies (FB) have been largely documented in the veterinary literature, with common sites including the ear canal, nasal cavity,

eye and eyelids, subcutaneous space, peritoneal and retroperitoneal spaces, thoracic airways and pleura or interdigital space (Brennan and Ihrke, 1983; Schultz and Zwingenberger, 2008; Cherbinsky et al., 2010; Vansteenkiste et al., 2014; Caivano et al., 2016; Fau-

chon et al., 2017; Marchegiani et al., 2017). The presence of this type of FBs can be confirmed by their direct visualization when relatively superficial or through the use of imaging techniques. Ultrasonography (US) is a common imaging modality used to search for them, due to its availability, superficial localization of the FBs in the early stages of the disease and its affordable cost (Frendin et al., 1999). Advanced imaging techniques such as CT or MRI have also been described but are usually used for chronic and deep migrations of the vegetal FBs (Frendin et al., 1999; Schultz and Zwingenberger, 2008). The ultrasonographic appearance of migrating grass seeds ('foxtail') has been well documented and is characterized by a spindle-shaped structure with two or three linear, hyperechoic interfaces, occasionally associated with acoustic shadowing (Gnudi et al., 2005). Typical grass seeds are fragments from wild oat species, and *Avena* spp. appear to be the most common migrating Gramineae FBs in the Mediterranean area (Schultz and Zwingenberger, 2008; Del Signore et al., 2017).

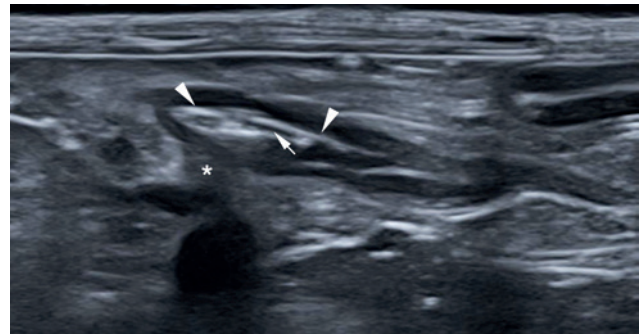
Up to 96% of the migrating FB cases have been reported to be associated with an inflammatory reaction (Vansteenkiste et al., 2014). This can include cellulitis, abscess, exudate and fistulous tracts (Gnudi et al., 2005; Vansteenkiste et al., 2014).

Vegetal FB migration within the urogenital tract has been sporadically reported, including the urethra, urinary bladder, penis and vagina (Brennan and Ihrke, 1983; Cherbinsky et al., 2010; Gatel et al., 2014; Fabbi et al., 2014, Agut et al., 2016; Del Signore et al., 2017). To date, two cases of intrauterine vegetal FB migration have been reported in bitches (Walker, 1978; Wolff, 1978). However, the ultrasonographic features of intrauterine vegetal FBs have not been documented to the author's knowledge.

The aim of this study was to describe the ultrasonographic findings associated with intrauterine vegetal FB migration in bitches. The authors hypothesized that intrauterine migrating vegetal FBs induce alterations to the uterine horns or body and in the adjacent intraperitoneal fat on ultrasonographic examination.

## MATERIALS AND METHODS

In this retrospective case series, the database of two referral private practices, i.e. Azurvet, Center of Veterinary Specialists and Olliolis, Veterinary Referral Center (France) was searched for intrauterine vegetal FBs. Both referral practices were located in the South East of France. Patients were included if the ultrasonographic examination revealed an intrauterine vegetal FB, that was subsequently confirmed at surgery, between April 2011 and January 2020. Exclusion criteria were a vaginal location of the FB or when an ultrasound-guided retrieval procedure was performed, which suggested that the FB was located at least partially in the vagina or cervix. Clinical data



**Figure 1.** Ultrasonographic appearance of the uterus and intrauterine FB (grass seed *Avena* spp.) in the left uterine horn of a four-year-old, spayed, female Border collie, using a linear transducer. Note the spindle-shaped, hyperechoic interface (arrow heads), with delineation of the barbed florets by scant anechoic fluid (arrow), and partial acoustic shadowing of the cranial aspect of the FB (\*). Note the uniform and non-thickened uterine wall at the level of the grass seed, and the collapsed uterine horn lumen distal to the FB.

collected from the animal's medical reports included clinical signs at presentation, breed, age, body weight, sexual status (intact versus neutered) and ultrasonographic findings. Ultrasonographic examinations were performed by an ECVDI diplomate or ECVDI associate member, highly experienced in the ultrasonographic diagnostics and management of migrating grass seeds as frequently encountered in this geographic area. Scans were performed using TOSHIBA Aplio 400, TOSHIBA Aplio 600, ESAOTE MyLab 60 and PHILIPS CX50 ultrasound machines. Ultrasound reports, images and recorded videos, when available, were retrospectively evaluated for each included animal, in order to provide a detailed description of the ultrasonographic features.

## RESULTS

Eleven dogs were included in the study. Ten bitches had been neutered via ovariectomy without hysterectomy, and one was intact. Ages ranged from ten months to fourteen years old (median seven years old). Represented breeds included Yorkshire terrier, Lhasa Apso, Bichon Frisé, West Highland White terrier, Griffon hunting dog Wirehaired Pointing Griffon, two Border collies and four mixed breed dogs. Body weights ranged from 5kg to 25kg (median 8kg).

In all animals, the clinical signs were characterized by hemorrhagic or purulent vulvar discharge and vulvar discomfort. The duration of the clinical signs prior to referral was not documented in all cases. A chronic evolution of over three weeks had been recorded in three bitches (three weeks in two bitches and five weeks in one bitch).

In the ten neutered dogs, the spindled-shaped ultrasonographic image typical of grass seeds (most likely

consistent with *Avena sterilis* sp.) was observed, and was identified in the left uterine horn in six animals and in the right uterine horn in four animals (Figure 1). One of these dogs presented with two overlapping FBs within the right uterine horn.

The size of the FBs ranged from 12 to 32 mm in length (median 20 mm) and from 1.7 to 5.5 mm in width (median 3 mm). In all ten dogs, a very small amount of intraluminal fluid was present surrounding the FB, making it more conspicuous. Focal ovoid dilatation of the uterus was noted at the location of the intraluminal FB, ranging from 2.8 to 8.1 mm in diameter (median 5 mm), depending on the cross-sectional diameter of the foreign body. In 8/10 dogs, intraluminal fluid was only localized around the FB, whereas the two remaining dogs showed mild diffuse accumulation of fluid in the entire uterine lumen.

In 9/10 dogs, the focally dilated uterine segment exhibited a homogeneous wall, with normal wall thickness and echogenicity, similar to the adjacent, unaffected uterine segments. The uterine wall layers could not be differentiated in either affected or unaffected uterine segments (Figure 2A). In 1/10 dogs, the report did not specify the appearance of the uterine wall at the level of the FB.

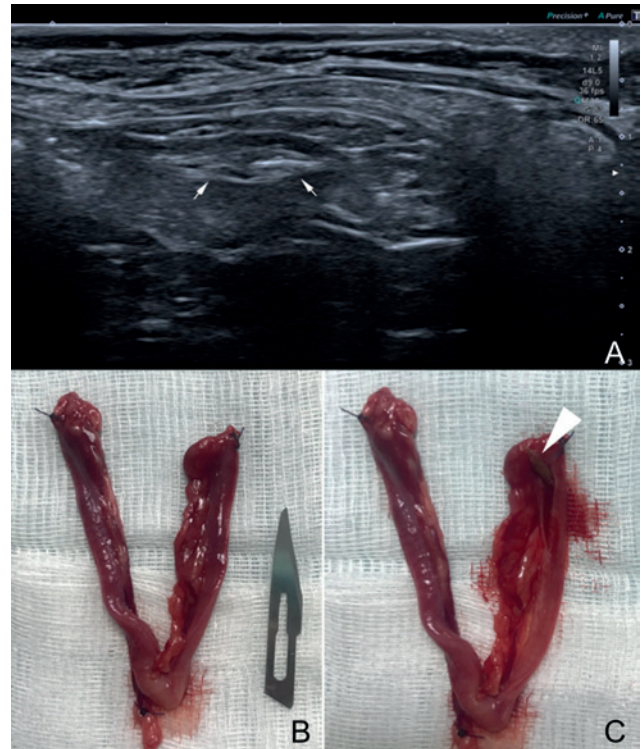
In 8/10 dogs, the uterine segments remote from the FB were reported to be unremarkable. Mild focal hyperechogenicity of the peritoneal fat surrounding the uterine segment containing the FB was noted in 1/10 dogs. In 1/10 dogs, the report did not specify the appearance of the uterus remote from the FB.

The intrauterine FB was identified as an *Avena sterilis* spikelet in all ten neutered dogs (Figures 2B and 2C).

In the intact dog, multiple hyperechoic foci and linear interfaces associated with acoustic shadowing were observed within the lumen of the cranial part of the uterine body (Figure 3A). At this level, the uterine wall was markedly thickened, forming a mass. There was pseudo layering on the ventral aspect of the lesion, consisting of an inner, hypoechoic layer and an outer, more echogenic layer (Figure 3A). Focal moderate hyperechogenicity of the surrounding peritoneal fat was noted around the mass (Figure 3B). Even though there was no ultrasonographic evidence of uterine perforation, this was subsequently detected during the ovariohysterectomy performed by the referring veterinarian. The FB was identified as a *Poa pratensis* spikelet (Figure 3C).

## DISCUSSION

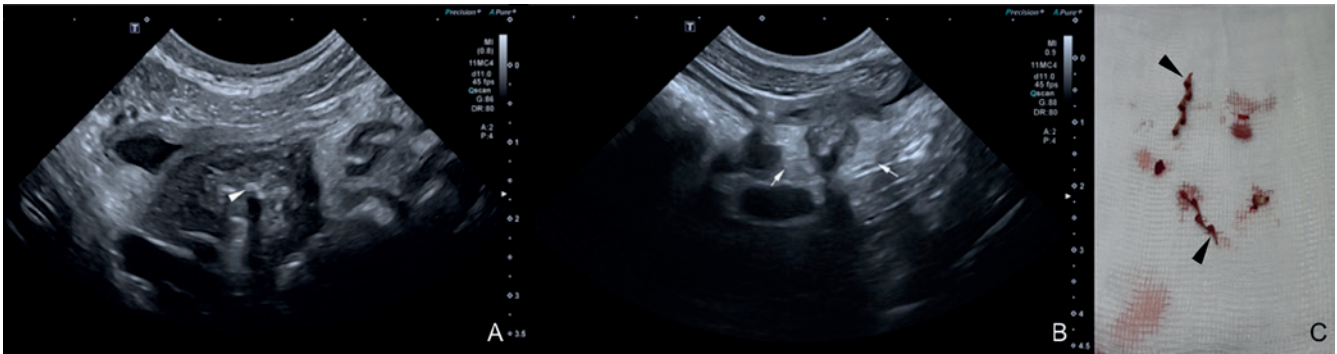
The presence of grass seeds in the vagina has been described previously (Gatel et al., 2014). Cranial migration of spikelets from the vaginal vestibule is caused by the stiff, reverse barbs that promote forward movement while preventing backward motion (Brennan and Ihrke, 1983; Schultz and Zwingerberg-



**Figure 2.** A. Ultrasonographic appearance of the intrauterine *Avena* spp. grass seed (white arrow) located in the left uterine horn of a five-year-old, spayed, female Chihuahua, with a typical, spindle-shaped, hyperechoic interface. B. Hysterectomized uterus of the same dog. Note the normal macroscopic appearance of the uterine horn. C. After incision of the left uterine horn, with partial exteriorization of the grass awn (white arrow head).

er, 2008; Gatel et al., 2014). In the present cases, the plant material most likely migrated from the vagina, through the cervix and into the uterine horns. In fact, uterine cannulation can be performed at any stage of the reproductive cycle in bitches (Watts and Wright 1995), which suggests that the uterine cervix may be patent to the migration of small vegetal FBs irrespective of the hormonal cycle of the dog. The close proximity of the vulva to the ground in female dogs during micturition might promote the penetration of grass seeds into the vulva, as previously suggested (Gatel et al., 2014). This proximity may be exacerbated in small dogs, and could be the reason for the overrepresentation of dogs weighting < 10kg in the present study (8/11).

Ascending and descending contractions of the vagina and uterus during estrus and anestrus have been documented, and could have contributed to the retrograde migration in the intact bitch (Brennan and Ihrke, 1983; Chatdarong et al., 2006; Snead et al., 2010; Gatel et al., 2014). The patency of the cervix is also increased during proestrus and estrus, parturition, and the post-partum period up to sixty days after parturition (Allen and France, 1985; Silva et al., 1995; Verstegen et al., 2001; De Cramer and Nöthling, 2017).



**Figure 3.** A. Ultrasonographic appearance of the intrauterine *Poa pratensis* grass seed located in the uterine body of a four-year-old, cross-bred, intact, female dog. Note the multiple hyperechoic foci within the uterine lumen (arrow head) and the circumferential thickening of the uterine wall with pseudo layering. B. Hyperechoic fat surrounding the uterine body, consistent with focal steatitis (white arrow). C. *Poa* species grass seed (arrow head) extracted from the uterine body following hysterectomy.

However, the stage of the estrus cycle when the penetration and migration of the FB occurred in the intact bitch described in this series was not recorded at the time of presentation. Moreover, the exact duration of the clinical signs was not recorded, which prevents an estimation of the stage of the cycle.

In the present study, the majority of bitches (10/11) had been neutered via ovariectomy only. Currently, ovariectomy is the recommended surgical neutering prophylactic procedure in healthy bitches in France, according to the guidelines of the French Central Canine Society (<https://www.centrale-canine.fr>). The reason why ovariectomy is preferred in France rather than ovariohysterectomy is poorly documented, but ovariectomy seems to be a historically preferred technique. This surgical preference makes observation of intrauterine migration of foreign body more likely in France and some other European countries than in Northern American countries, where ovariohysterectomy is usually performed (DeTora and McCarty, 2011).

In all neutered dogs of the present series, the FBs were identified as being *Avena sterilis* spikelets. Ultrasonographic features of the grass seeds were consistent with previous descriptions (Staudte et al., 2004; Gnudi et al., 2005). In these cases, focal dilatation of the uterine horn, centered on the FB, helped to recognize the affected segment of the uterine horn; however, the ultrasonographic changes were very mild and localized. This is in contrast with descriptions of *Avena* spp. migration in other locations, which is generally associated with a marked inflammatory reaction, such as pyothorax, subcutaneous cellulitis or abscesses (Gnudi et al., 2005; Vansteenkiste et al., 2014) coughing (28%. In a previous study by Gatel et al. (2014), mild ultrasonographic changes associated with vaginal migration of vegetal grass seeds has also been reported in a spayed dog and a cat, even though it was suspected that the spikelet had already been in the vaginal lumen of the dog for at least two years.

The reason for this limited inflammatory reaction associated with genital migration of FB may be ex-

plained by the tubular and confined aspect of the uterus and vagina, and also by the discharge of inflammatory fluid via the vulva, observed in all dogs in this study. However, an increased tolerance of the uterus to the FB compared to other migration sites cannot be ruled out. Moreover, the absence of hormonal impregnation in the ovariectomized dogs in this study may have limited the inflammatory focal response to the vegetal FB, as hormones, progesterone in particular, are known to be implicated in the development of uterine diseases such as pyometra (Hagman, 2018). The impact of hormonal impregnation in the intact dog of the present series could not be determined, as the stage of its cycle was not recorded at the time of diagnosis.

Pyometra associated with a non-vegetal intrauterine FB has been reported, including in association with a retained swab fragment in a bitch (Ajadi et al., 2018). Endometrial hyperplasia and bacterial endometritis have also been reported in a guinea pig with an intra-uterine piece of hay (Kohutova et al., 2018). None of the neutered bitches in the present study showed any ultrasonographic abnormalities of the uterine wall. Two dogs in the study had a scant amount of diffuse intraluminal fluid, which could indicate endometritis or early pyometra. However, no cytological or bacteriological examination of the fluid was performed following the diagnosis of intrauterine vegetal FB.

In the present case series, only one intact bitch was included. The plant material retrieved at surgery was identified as a *Poa pratensis* spikelet, rather than the *Avena* spp. found in all the other dogs. To the authors' knowledge, this plant has not been reported as a migrating FB and has therefore never been described ultrasonographically. It had a non-characteristic appearance, consisting in multiple hyperechoic foci and linear interfaces, making the ultrasonographic diagnosis more challenging. This case presented with thickening of the uterine body and parietal alterations, consisting in marked uterine wall thickening and pseudo-layering. This may be explained by several factors,

including the hormonal status of the bitch, the different nature of the FB and the uterine wall perforation detected at surgery.

In human medicine, different complications can occur as a result of FB migration within the vagina or uterus, especially with intra uterine contraceptive devices, including perforation, fistulation or aberrant migration (Magudapathi et al., 2015; Huang et al., 2019; Li et al., 2019). Complications such as urethrovaginal fistula secondary to a migrating grass seed (Agut et al., 2016) or uterine perforation and metritis with severe uterine adhesions, secondary to intramural retained fetal material (Watson et al., 2016), have been reported in bitches. Uterine perforation in dogs has also been described secondary to trauma during pregnancy, uterine torsion, dystocia, pyometra and surgical scars (Hajurka et al., 2012; Voorwald et al., 2012; Watson et al., 2016). However, to the authors' knowledge, rupture or perforation of the uterus secondary to a migrating grass seed has previously not been reported in dogs.

The ultrasonographers that took part in the present study were highly experienced in the ultrasonographic detection of migrating grass seeds in small animals due to the high incidence of grass seeds around the Mediterranean Sea. In the authors' experience, the diagnosis of intrauterine vegetal FBs is considered challenging compared to more common migration sites. The subtle features noted in the majority of cases in the present study required a meticulous evaluation of the entire length of the uterine horns. The overrepresentation of small-sized, ovariectomized bitches in the affected population added extra difficulties, including the small diameter of the uterus and the random position of the uterine horns permitted by the section of the ovarian ligaments during ovariectomy. Finally, the absence of systematic warning signs such as peritoneal steatitis surrounding the affected horn or marked focal uterine dilatation could not be used to attract the attention of the operator to the FB.

The limitations of this study are mainly related to its retrospective nature. No histologic examination of the uterine horns containing the FB was performed, which prevented a comparison between the ultrasonographically normal uterine walls and the presence of potential microscopic evidence of metritis or endometritis. Additionally, the nature of the focal fluid outlining the FB and potential bacterial contamination were not documented by the referring veterinarians who performed the hysterectomy. Limited recorded data were available regarding the treatment received by the animals prior to referral, and their potential impact on the severity of the changes. Finally, all animals were referred specifically for ultrasonographic examination, without a prior specific clinical examination of the reproductive tract.

In conclusion, intrauterine vegetal FBs should be included in the differential diagnosis in any female dog with vulvar discharge, especially if ovariecto-

mized and living in a geographic area where migrating grass seeds are a common problem. Ultrasonographic findings in intra-uterine migrated vegetal FBs (grass seeds in the current cases) differ from those in other, more common sites of migration, since the changes observed were mostly very localized and mild. Notably, the absence of visible uterine wall abnormalities and a normal appearance of the uterus outside of the FB location were a common finding in the present study. Moreover, the ultrasonographic diagnosis of vegetal FB was found to be more difficult in the case of the atypical *Poa* spp. grass-seed. The paucity of ultrasonographic changes in most cases hence require a meticulous examination of the entire uterus in dogs suspected of intrauterine vegetal FB.

## ACKNOWLEDGEMENTS

The authors thank Dr Xavier Levy (DipECAR-EBVS) for his valuable suggestions.

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