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Author(s)	Fujita, Atsushi; Tsuboi, Masaya; Uchida, Kazuyuki et al.
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NOTE

Complex malformations of the urogenital tract in a female dog: Gartner duct cyst, ipsilateral renal agenesis, and ipsilateral hydrometra

Atsushi Fujita[1,*], Masaya Tsuboi[2], Kazuyuki Uchida[2] and Ryohei Nishimura[1]

[1]Veterinary Medical Center, the University of Tokyo, 1–1–1 Yayoi, Bunkyo-ku, Tokyo 113–8657 JAPAN

[2]Department of Veterinary Pathology, the University of Tokyo, 1–1–1 Yayoi, Bunkyo-ku, Tokyo 113–8657 JAPAN

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Abstract

A 10-month-old female toy poodle was referred to the University of Tokyo Veterinary Medical Center with a urogenital anomaly found during sterilization. An exploratory laparotomy revealed a cyst adhering to the cervix and a unilateral renal agenesis. Histopathology and immunohistochemical analysis of the cyst was consistent with remnants of the Wolffian duct or a Gartner duct cyst. This is a rare case of a canine Gartner duct cyst with renal agenesis and uterine anomaly. We discuss the similarity of this case to that of humans and introduce a classification in the literature for these complex urogenital malformations for further clinical research into the precise diagnosis and appropriate surgical planning.

Key Words: Dog, Gartner duct cyst, Renal agenesis

The Wolffian duct, especially the distal part, undergoes a delicate development process.[10,16] It mainly occurs in its 36 to 46 days gestation in dogs.[16] If the duct degenerates insufficiently, cystic remnants of the duct may develop around the uterus and vagina, and form a single or multiple Gartner duct cyst(s). As the ureteral bud sprouts from the Wolffian duct, Wolffian duct malformations can be associated with ipsilateral renal agenesis.[1,18] Due to the Wolffian duct's inductive function on the Mullerian duct, uterine and vaginal malformations can also occur with Wolffian duct malformations.[2,18]

Wolffian malformations in humans are very rare and the incidence of complex malformations of a Gartner duct cyst with ipsilateral renal agenesis is reported as 0.0025% (7/280,000).[17] One study reported that all cases (n = 10) of a Gartner duct cyst with unilateral renal agenesis had Mullerian malformations (hydrometra, hydrocolpos, hematocolpos, or hematocolpometra).[18] In veterinary literature, McIntyre investigated

*Corresponding author: Atsushi Fujita, 1–1–1 Yayoi, Bunkyo-ku, Tokyo 113–8657 JAPAN
Fax: +81–3–5841–8996. E-mail: pikkary@gmail.com
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gross uterine (Mullerian) anomalies in cats and dogs undergoing elective ovariohysterectomy and identified uterine anomalies (unicornuate uterus, segmental uterine agenesis, uterine horn hypoplasia) in 0.05% (15/32,600) of dogs.[14] The authors found unilateral renal agenesis in 50% (5/10) of dogs with uterine malformations, but this report did not describe Wolffian anomalies including Gartner duct cyst. Although some case reports described a single or multiple Gartner duct cyst(s) in dogs,[3,5,11,13,19,20] neither referred to the presence of renal agenesis nor Mullerian anomaly. Thus, the clinical information of complex urogenital anomalies is still limited.

In this report, the details of such malformations including a large Gartner duct cyst in a female dog are discussed with regards to the literature in humans, along with their embryologic and clinical significance.

A 10-month-old female toy poodle showing no clinical signs was taken to the referring veterinarian for sterilization. During ovariohysterectomy, the referring veterinarian found malformations including right renal agenesis and right uterine horn swelling, as well as a cyst around the urinary bladder (Fig. 1). The veterinarian resected the bilateral ovaries and uterine horns. By histopathological examination, both ovaries were apparently normal and hydrometra was noted in the right uterus.

The dog was referred to the University of Tokyo Veterinary Medical Center (UTVMC) for further evaluation of the urogenital malformations and the cystic lesion around the bladder. At initial presentation, radiography and ultrasonography revealed a cystic lesion caudodorsal to the urinary bladder, without apparent communication to the urinary tract (Fig. 2) and the absence of the right kidney. The biochemistry of the yellowish serous fluid aspirated from the cyst suggested that the fluid contained urine (USG = 1.014, BUN = 25.7 mg/dL, Cre = 37.4 mg/dL, Bacterial culture: negative), although we failed to compare it with the urine. The lesion was suspected as an ectopic

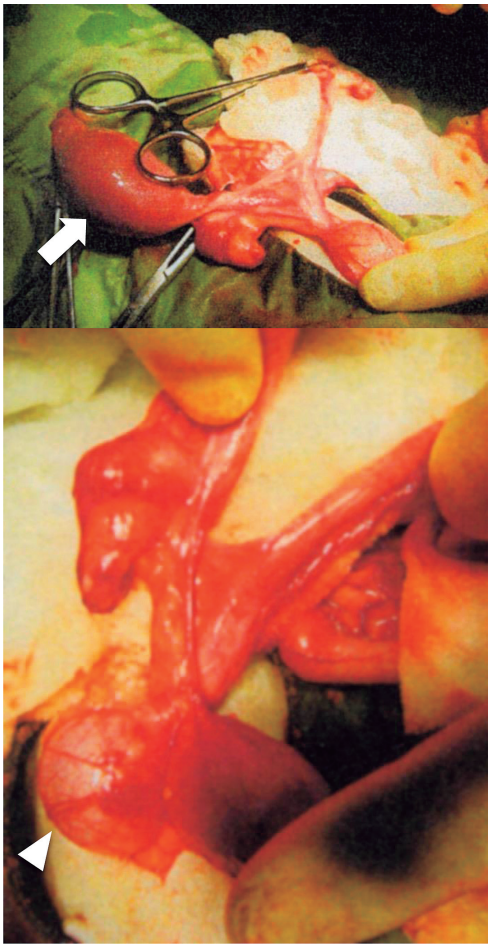

Fig. 1. Hydrometra (arrow) and a cyst (arrow head).

ureterocele or vaginal cyst. An exploratory laparotomy was proposed to the owner to diagnose and resect the cystic lesion to reduce the risk of enlargement or urinary infection, though the owner refused the operation at that time. However, when the dog was 16 months old, the owner requested the exploratory procedure. At the time of representation, the dog had no clinical signs and the size of the cyst did not change.

The following day, the dog was induced to anesthesia using fentanyl and propofol, and maintained with isoflurane and fentanyl. Cefazolin was used for perioperative antibiotics. The exploratory laparotomy revealed that right kidney and ureter were grossly absent. The cyst was located in the caudodorsal area of bladder and macroscopically adhered to the right side of

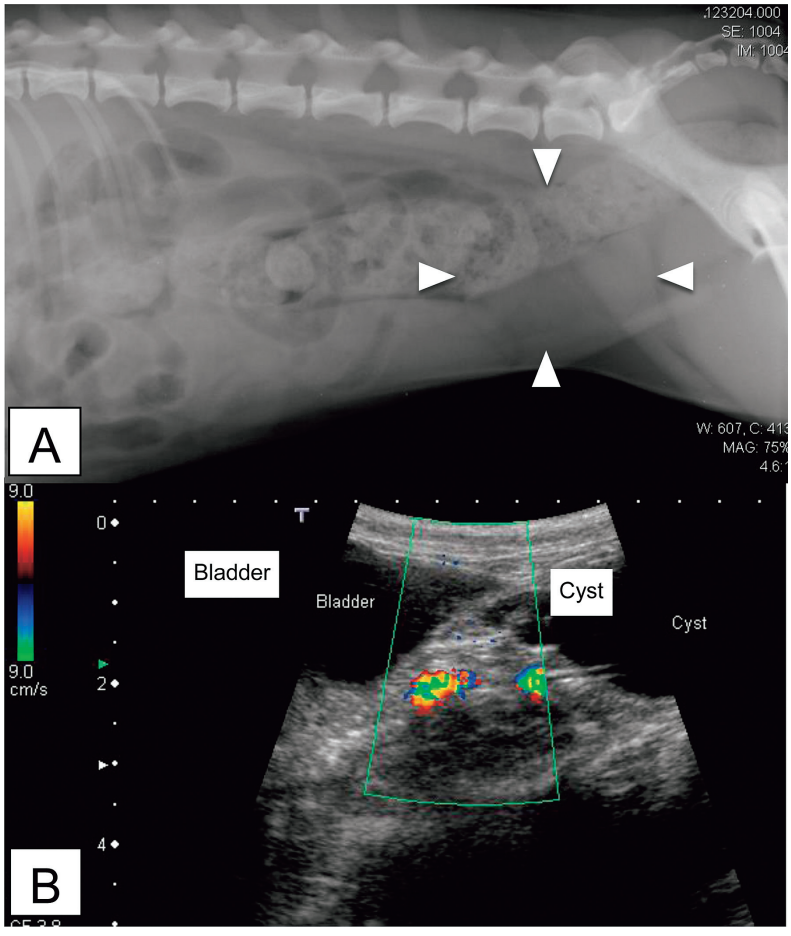

Fig. 2. A lateral radiograph of abdomen (A) and caudal abdominal ultrasonography (B) in the oblique position including both bladder and the cyst. (A) The soft tissue density mass (arrowhead) was observed caudal to bladder. (B) The cyst was locatd right caudal to the bladder and no apparent communication between them.

the cervix. It was also connected to bladder wall by cord-like structure (Fig. 3). There was no apparent change at the bladder wall. The left kidney, left ureter and urethra looked normal. There was no inflammatory change except the sites of previously excised uterus horns. After separating mild adhesion around the horns, cord-like structure was ligated using a 4-0 polydioxanone absorbable suture and disconnected from the bladder wall. Vaginal wall was dissected at the level of caudal to the cyst adhesion and sutured in simple continuous pattern using a 4-0 polydioxanone suture, and then the cyst was resected *en bloc* with cervix. The abdominal wall was closed in an ordinary manner. The recovery was uneventful.

The resected tissue was fixed in 10% neutral buffered formalin, processed routinely, and embedded in paraffin. 4 μm thick-sections were stained with hematoxylin and eosin (HE). Immunohistochemistry was also performed using the Envision polymer system (Dako-Japan, Kyoto, Japan). The primary antibodies used were mouse anti-cytokeratin AE1/AE3 (Dako-Japan) and mouse anti-uroplakin III (Progen Biotecknik, Heidelberg, Germany) monoclonal antibodies. Counterstaining was performed with Mayer's hematoxylin.

Histopathologically, the cyst wall consists of inner thick collagenous tissue with abundant capillary vessels, and outer thin layer of smooth muscle (Fig. 4A). Inner cavity of the cyst was

lined by monolayer of cuboidal epithelium, or in part by transitional epithelium that resembles uroepithelium (Fig. 4B). Peripheral nerves were occasionally observed at the outer layer of the cyst wall. These findings are consistent with the previous reports of Gartner duct.[3] Inflammation was not observed throughout the cyst wall. Immunohistochemically, both monolayer and transitional epithelium were positive to cytokeratin AE1/AE3 (Fig. 4C) and uroplakin III (Fig. 4D). This results indicated that the cyst was lined by urinary epithelium rather than vulvar epithelium.[4] The Gartner duct cyst was diagnosed by the clinical findings and histological feature.

The dog is three years old at the time of writing and shows no clinical signs.

This dog had three major malformations: A Gartner duct cyst (Wolffian anomaly), ipsilateral renal agenesis, and ipsilateral hydrometra (Mullerian anomaly). The malformation of the distal portion of the Wolffian duct inhibits the sprouting of the ureteral bud and is followed by renal agenesis. Furthermore, these abnormal signals affect the Mullerian duct development of the uterus and cause anomaly (hydrometra, hematometra, hydrocolpos or hematocolpometra).[2,18] Acién, *et al.* described female genital malformations in humans, and classified them into five categories (Table 1).[1] According to this system, the present case can be categorized into the category 5 (the combination of 2b and 3). Some differences may exist between human and canine urogenital genesis, but our findings suggest a similar pathogenesis between the two species, as in Acién's description.

Different surgical approach is indicated depending on the cyst location. The cyst around the uterus, standard ovariohysterectomy is curable. For the cyst around cervix or cranial vagina, the resection via laparotomy can be successful.[13,19,20] Vaginal cyst extended to pelvic cavity can be drained and marsupialized via episiotomy.[5,9] If clinical diagnosis were made before operation, a wait-and-see approach can be

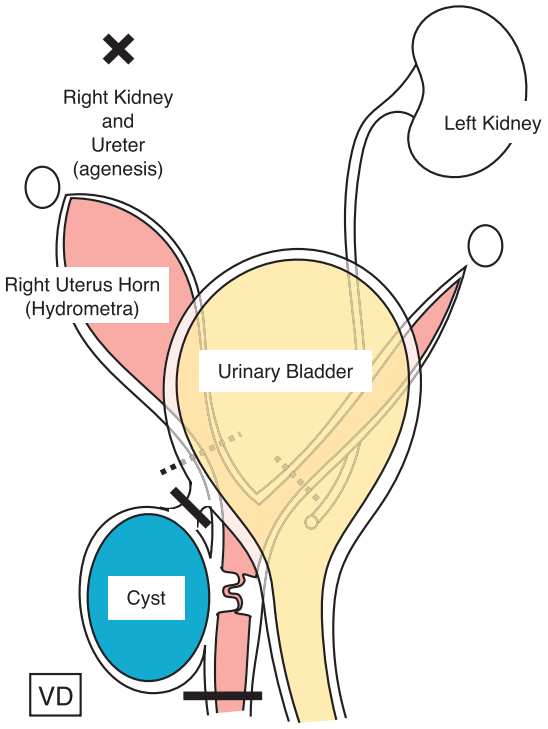

Fig. 3. Schematic representation of the findings combined from the two operations in the ventrodorsal view. The Dotted lines and the solid lines are the resection line at the first and the second operation, respectively. Gartner duct cyst is located on the right ventral wall of the cervix/vagina. Renal agenesis is ipsilateral to the cyst. Hydrometra is ipsilateral to the other malformations. There are no apparent communications between the cyst lumen and surrounding cavities.

taken for asymptomatic cases.[12,18] We performed a laparotomy to make a definitive diagnosis and to reduce the risk of urinary problems in the future.

Although the cyst contained urine-like fluid and the cyst was suspected to communicate to urinary tract or vagina, the route of it could not be confirmed. Some reports described the communication between a Gartner duct cyst and urinary system,[6,15,18] but the characteristics of the fluid was not analyzed in these reports. In the present case, the communication between bladder and the cyst may have existed in its gestation or neonatal period, but closed before the time of surgery.

Because of the complexity of the malformations, Gartner duct cysts can be misdiagnosed and treated inadequately. Recurrent

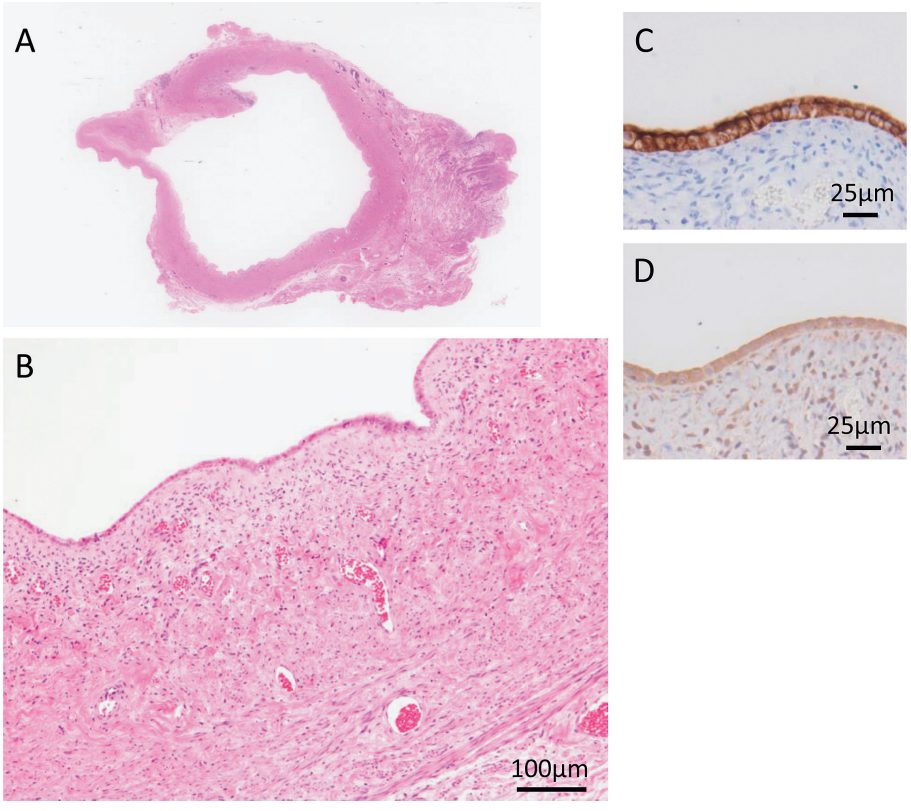

Fig. 4. Histopathology of the cyst. (A, B) HE stain. The cyst is lined by cuboidal columnar or partially pseudostratified epithelium and surrounded by a circular smooth muscle layer. Immunohistochemical analysis: (C) cytokeratin AE1/AE3 and (D) Uroplakin-III. The lining epithelium was positive to both antibodies.

Table 1. Clinical and embryological classification of the malformations of the female genital tract

1. Agenesis or hypoplasia of a whole urogenital ridge: Unicornuate uterus with uterine, tubal, ovarian and renal agenesis on the contralateral side.

2. Mesonephric anomalies with absence of the Wolffian duct opening to the urogenital sinus and of the ureteral bud sprouting (and therefore, renal agenesis). The 'inductor' function of the Wolffian duct on the Mullerian duct is also failing and there is usually: Utero-vaginal duplicity plus blind hemivagina ipsilateral with the renal agenesis, clinically presented as:
   a) Large unilateral hematocolpos*
   b) Gartner's pseudocyst on the anterolateral wall of the vagina*
   c) Partial reabsorption of intervaginal septum, seen as a 'buttonhole' on the anterolateral wall of the normal vagina which allows access to the genital organs on the renal agenesis side.
   d) Vaginal or complete cervico-vaginal unilateral agenesis, ipsilateral with the renal agenesis, and (1) with no communication, or (2) with communication between both hemiuteri (communicating uteri).

3. Isolated Mullerian anomalies affecting:
   a) Mullerian ducts: they are the common uterine malformations as unicornuate (generally, with uterine rudimentary horn), bicornuate, septate and didelphys uterus.
   b) Mullerian tubercle: cervico-vaginal atresia and segmentary anomalies such as transverse vaginal septum.
   c) Both, Mullerian tubercle and ducts: (uni- or bilateral) Mayer-Rokitansky-Kuster-Hauser syndrome.

4. Anomalies of the urogenital sinus: cloacal anomalies and others.

5. Malformative combinations: Wolfian, Mullerian and cloacal anomalies.

*These types can associate a vaginal ectopic ureter and interseptal or interu- terine communication.
(Pedro Acién, Maribel Acién, Marisa Sánchez-Ferrer, Complex malformations of the female genital tract. New types and revision of classification:, Human Reproduction, 2004, 19(10), p2377–2384, by permission of Oxford University Press)

complex cases were reported both in human and dog.[7,20] Embryological aspects should be considered prior to any treatment decision. Computed tomography (CT) or magnetic resonance imaging (MRI), in addition to abdominal ultrasound and urethrogram, may be useful for treatment planning.[7,8]

This report described the embryology of a complex urogenital malformation in a dog, and discussed its associated clinical considerations. As aforementioned, Gartner duct cyst should be added to the differential diagnoses for cystic lesions around the urogenital tract, especially in female dogs with ipsilateral renal agenesis or uterine anomaly.

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