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Note

Investigation of preinguinal approach for removal of urachal abscess in three Japanese black cattle older than 18 months of age

Reiichiro Sato[1*], Jun Hayashi[2], Naoyuki Fuke[3], Eren Saito[3], Kanako Hidaka[2], Hideki Saka[2]

Hiroyuki Satoh[1] and Adrian Steiner[4]

[1] Graduate School of Medicine and Veterinary Medicine, University of Miyazaki, 1-1 Gakuen Kibanadai-nishi, Miyazaki 889-2192, Japan

[2] Miyazaki Agricultural Mutual Aid Association, 118 Miyawaki-cho, Miyazaki 880-0877, Japan

[3] Faculty of Agriculture, University of Miyazaki, 1-1 Gakuen Kibanadai-nishi, Miyazaki 889-2192, Japan

[4] Vetsuisse Faculty, Clinic for Ruminants, University of Bern, Bern 3001, Switzerland

***CORRESPONDING AUTHOR**

Reiichiro Sato

E-mail: r-sato@cc.miyazaki-u.ac.jp

RUNNING HEAD

PREINGUINAL APPROACH FOR URACHAL ABSCESS

ABSTRACT

This study investigated the diagnostic and surgical management of urachal abscessation involving the urinary bladder in three cattle aged >18 months. While the abdominal floor or paralumbar fossa are typically considered for accessing the urachus and bladder in calves and heifers, the distance is too great to perform the procedure under direct vision in adult cows. Therefore, a novel preinguinal approach was used for access in cows with urachal abscesses after 18 months. Access was successfully achieved in all the three cows through a preinguinal incision to the urachal abscess at the apex of the bladder. However, in cases wherein the abscess and adhesions are severe, removal may be challenging or may necessitate a combined median or paramedian approach.

KEY WORDS

cattle, preinguinal approach, surgical management, ultrasonography, urachal abscess

The fetal umbilical cord consists of two umbilical veins, one urachus, and two umbilical arteries. The umbilical veins merge to form one single intra-abdominal vein at the level of the body wall. The fetal urachus connects the allantois bladder to the apex of the urinary bladder [2], tears at birth, and is passively pulled back toward the apex of the urinary bladder by the two actively retracting umbilical arteries located to the left and right of the urachus. Urachal diseases result from incomplete or abnormal involution of this structure after birth. Urachal abscessation is the consequence of ascending bacterial infection of urachal remnants at or after birth [3, 10]. These urachal abscesses can cause fever, swelling and pain on palpation of the umbilical region, drainage of pus from the umbilical region, and dysuria (frequent urination of small amounts). In calves, diagnosis can be established through deep palpation [2]. Additionally, ultrasonography can aid in noninvasively and reliably diagnosing conditions within the deep abdominal cavity [4, 9, 16]. However, diagnosis of an abnormality in the urachus is difficult in the absence of umbilical abnormalities, dysuria, or other clinical signs [7, 8, 13, 17].

Most commonly, the surgical approach for resection of urachal remnants includes circumcision of the external umbilicus and prolongation of the surgical incision in the median or paramedian direction caudally [2,3]. In case of connection between the urinary bladder and the urachal abscess, which is most often the case, a portion for the apex of the urinary bladder has to be resected along with the urachus. In young cattle, the apex of the urinary bladder can easily be approached through the caudal area of the surgical incision wound. However, in heifers exceeding 12 months of age and cows, access to the apex of the urinary bladder via a median, paramedian, or paralumbar fossa, allowing for surgical manipulation under visual control, may be difficult or even impossible.

For cesarean section of dairy and beef cattle, a ventrolateral incision directed toward the inguinal region may be performed to easily exit the uterus through the wound with the cow in right lateral recumbency [14]. Compared to a median or paramedian incision, a ventorateral incision is easier to

extend the incision line caudally, making it suitable for the removal of large emphysematous fetuses [14].

Although there have been many reports of urachal disease in calves and young heifers [1, 5, 8, 12, 13, 15, 18-20], to the best of our knowledge, reports of its surgical management in heifers or adult cattle are unavailable. Therefore, the purpose of the present case report is to describe the advantages and limitations of a preinguinal approach for surgical management of urachal abscessation in two heifers and one cow.

Case 1 involved a 19-month-old female Black Japanese heifer weighing 304 kg. She had never shown any abnormalities since birth and had never been treated by a veterinarian. Artificial insemination was performed at 15 months of age, during which a mass approximately 15 cm in diameter was palpated below the uterus. The mass appeared adherent to the surrounding tissue and had a smooth surface. Over a period of approximately 4 months of monitoring, no change was observed in the mass. At 19 months of age, she was referred to the Miyazaki University Veterinary Teaching Hospital for diagnostic and prognostic evaluation and potential treatment.

At admission, she exhibited a reduced appetite and hypodynamia, the heart rate, respiratory rate, and rectal temperature were at 80 beats/min, 34 breaths/min, and 39.2°C, respectively. The heifer intermittently exhibited a hunchback posture and a raised tail in attempts to urinate; however, she only voided small amounts of urine each time. Rectal palpation revealed a mass of approximately 10 cm in diameter, situated on the ventral aspect of the uterus.

Complete blood count results were within the normal ranges (white blood cell count [WBC], 8,180 cells/μL; red blood cell count [RBC], 632×10^4 cells/μL; and thrombocytes [PLT], 31.5×10^4 cells/μL) and serum examination revealed no abnormalities (total protein [TP], 6.4 g/dL; blood urea nitrogen, [BUN], 7.2 mg/dL; and creatine [Cre], 1.46 mg/dL).

Rectal ultrasonography, performed with a 13.0 MHz linear probe (MyLab One VET; Esaote Maastricht, Netherlands), confirmed the presence of a mass (approximately 12 × 11 × 10 cm in size) at the apex of the bladder. The mass was characterized by a capsule and hyperechogenic contents, allowing the diagnosis of an abscess (Fig. 1A). The abscess was formed only at the tip of the bladder, and neither communication with the umbilicus nor with the urinary bladder was observed. Urachal abscess formation with attachment to the apex of the urinary bladder and the ventral body wall was diagnosed.

Surgical removal of the abscess was planned. For that reason, the heifer was fasted for 36 hr before surgery, and at 1 hr before surgery a compound antibiotic containing 200,000 units of benzylpenicillin-procaine and 250 mg of dihydrostreptomycin sulfate (0.05 mL/kg; Mycillin Sol; Meiji-Seika Pharma, Tokyo, Japan) to prevent perioperative infection and flunixin meglumine (2 mg/kg; Forvet50; MSD, Tokyo, Japan) for pain relief were administered.

The heifer was sedated with intravenous xylazine hydrochloride (0.2 mg/kg, Selactar, Elanco Japan, Tokyo, Japan) and positioned in right lateral recumbency with the hind limb fixed in the abducted position (Fig. 2). General anesthesia was induced via continuous isoflurane administration (Isoflu; Zoetis Japan, Tokyo, Japan) at a concentration of 2% in oxygen. Local anesthesia was performed with procaine hydrochloride (Adsan; Riken Vets Pharma, Saitama, Japan) administered subcutaneously around the planned incision line in the left preinguinal area. The abdomen was opened via a skin incision and subsequent transection of the underlying abdominal wall layers in the left preinguinal area was performed, extending from the preinguinal region in the cranial direction at a length of approximately 15 cm.

The detailed examination of the abdominal cavity revealed that the abscess was located at the tip of the bladder and adhered to the ventral abdominal wall and the great omentum. After manual blunt dissection of the adhesions, the abscess could be exteriorized through the surgical incision wound (Fig.

1B). Because the border between the bladder apex and the abscess was not clear, two forceps were used to grasp the bladder apex and approximately 1.5 cm proximal to it. The mass was then covered with a sterile bag and removed along with a part of the bladder apex by excising between the forceps with a scalpel. The urinary bladder was sutured with a Continuous–Horizontal mattress double suture using a synthetic absorbable thread (PDS PLUS, USP 2-0; Johnson & Johnson K.K., Tokyo, Japan). The preinguinal region was closed with continuous suture using polyglycolic acid sutures composed of a synthetic absorbable multifilament suture material (USP 3+4, Opepolyx) in the order of the peritoneum, muscle, and fascia. The skin was closed with intradermal buried sutures composed of a synthetic absorbable multifilament suture material (USP 0, Vicryl; Johnson & Johnson, Tokyo, Japan).

The excised abscess measured 12 × 10 × 10 cm, weighed 539 g, and contained pus (Fig. 1C). Histopathological examination revealed that the abscess was contiguous with the bladder tissue, characterized by smooth muscle and connective tissue, but did not communicate internally with the bladder. The abscess was also encapsulated by highly hyperplastic fibrous connective tissue containing numerous blood vessels and lined with transitional epithelial cells. The final diagnosis was urachal cyst with abscess (Fig. 1D). Postoperatively, no particular complications were observed, and the heifer was reintroduced into the herd. Three weeks postoperatively, estrus was observed, an embryo was transferred and she was successfully pregnant.

Case 2 involved a 22-month-old male Black Japanese cow weighing 348 kg. Observed for the first time at the age of 4 months, he presented with signs of frequent small amounts of urination. Ultrasonographic examination by the farm veterinarian revealed no abnormalities in the umbilical region or in the abdominal cavity. However, urinary calculi were observed to have adhered to the preputial hair, and crystals were observed urine sediment analysis. The farm veterinarian diagnosed urolithiasis, and started treatment with ammonium chloride accordingly. At the age of 20 and 21 months, he was again

129 presented to the farm veterinarian with signs of dysuria, and hematuria was diagnosed for the first time.
130 Rectal examination by the farm veterinarian revealed a mass of approximately 10 cm in diameter at the
131 apex of the bladder. Thereafter, he was referred to Miyazaki University Veterinary Teaching Hospital
132 for diagnostic and prognostic evaluation and treatment.

133 Complete blood count results were within the normal ranges (WBC, 8,280 cells/μL; RBC, 664×10^4
134 cells/μL; and PLT, 58.2×10^4 cells/μL). The serum TP was elevated at 9.9 g/dL; no abnormalities were
135 noted in the serum BUN (8.4 mg/dL) and Cre (0.82 mg/dL). Rectal ultrasonography, performed with a
136 13.0 MHz linear probe (MyLab One VET), confirmed the presence of a mass (approximately 11 × 10 ×
137 10 cm in size) at the apex of the bladder. The mass was characterized by a capsule with hyperechogenic
138 contents, attached to the surrounding tissue. Furthermore, a sea anemone-like structure was observed,
139 originating from the inner wall of the bladder apex (Fig. 3A). No communication was noted between
140 the mass and the bladder. Urachal abscess formation with attachment to the tip of the urinary bladder
141 and the ventral body wall was diagnosed, and surgical removal envisaged.

142 Preparation for surgery, anesthesia and access to the abdominal cavity were similar as for Case 1.
143 Detailed manual exploration of the abdominal and pelvic cavity revealed that the abscess located at the
144 tip of the bladder had extensive adhesions to the tissue of the pelvic floor, great omentum, and abdominal
145 wall. The attempt to remove the adhesions was unfortunately unsuccessful, as manipulation under direct
146 view of the lesion was impossible. We finally judged that it was not possible to safely remove the abscess,
147 and we closed the abdomen as described for Case 1. He developed urinary retention due to urinary
148 calculi approximately 3 weeks after the surgery; therefore, we deemed the prognosis poor and submitted
149 the animal to necropsy.

150 Necropsy revealed an abscess at the tip of the bladder with extensive adhesions to the surrounding
151 tissue and a sea anemone-like structure protruding from the bladder wall to the lumen (Fig. 3B). The

abscess was characterized by a lining of transitional epithelial cells, similar to that in Case 1. Based on these findings, the final diagnosis was urachal cyst with abscess and chronic polypoid cystitis (Fig. 3C).

Case 3 involved a 26-month-old female Black Japanese cow weighing 364 kg who was presented to the farm veterinarian because of dysuria (frequently voiding small amounts of urine) for the first time two months earlier. This cow was referred to Miyazaki University after treatment with antibiotics was unsuccessful. At admission to the clinic, complete blood count results were within the normal ranges (WBC, 8,100 cells/μL; RBC, 732×10^4 cells/μL; and thrombocytes, 55.5×10^4 cells/μL). Serum analysis revealed no abnormalities (TP, 7.2 g/dL; aspartate aminotransferase, 54 U/L; BUN, 8.2 mg/dL; Cre, 0.71 mg/dL). Rectal ultrasonography, performed using the 13.0 MHz linear probe (MyLab One VET), revealed a highly echogenic mass extending continuously from the umbilicus to the bladder. The mass was considered urachal abscess extending from the urinary bladder to the inner aspect of the umbilicus (Fig. 4A). Furthermore, severe adhesions between the urachus and ventral abdominal wall were observed and surgical removal of the abscess was envisaged.

Surgical preparation, anesthesia administration and access to the abdominal cavity were similar as those for Case 1. Careful examination of the abdominal and pelvic cavities revealed extensive adhesions between the tip of bladder and the pelvic floor and between the urachal abscess and ventral abdominal wall, respectively.

Manual blunt dissection was employed to carefully separate the adhesions surrounding the urinary bladder and urachal abscess within the reach of the incision site, and the urinary bladder was pulled to the surgical incision wound. The urachal abscess was removed along with the tip of the bladder and sutured as described for Case 1. The separated urachus on the bladder side was covered with sterile plastic, and the open end was ligated with a nylon thread (USP 1, Nesco suture; Alfresa Pharma Co., Ltd., Tokyo, Japan). Attempts to manually detach the middle and cranial aspects of the urachal abscess

175 from the ventral body wall unsuccessful. After suturing the preinguinal wound, as described for Case 1,
176 the cow was repositioned in dorsal recumbency, and a left paramedian incision was made for further
177 exploration of the abdominal cavity. The left paramedian incision started approximately 10 cm caudal
178 to the xiphoid process, extending 5 cm from the median and progressing caudally from the umbilicus
179 for a length of 20 cm. Exploration of the abdominal cavity revealed that the urachal abscess was
180 extensively adhered to the abdominal wall, presenting challenges during excision. However, with careful
181 blunt dissection under visual control, the adhesions were successfully managed, facilitating removal of
182 the urachal abscess from the paramedian surgical incision wound. The peritoneum and muscular layer
183 of the paramedian incision was closed with a continuous suture pattern using a polyglycolic-acid
184 synthetic absorbable suture material (USP 5, Opepolyx). The subcutaneous tissue was closed with a
185 continuous suture pattern, using a polyglactin 910 synthetic absorbable suture material (USP 0, Coated
186 Vicryl), followed by closure of the skin with intradermal buried sutures composed of a synthetic
187 absorbable multifilament suture material (USP 0, Vicryl; Johnson & Johnson, Tokyo, Japan).
188 The largest area of the excised abscess was located at the tip of the bladder, measuring 13 × 11 × 10
189 cm, weighing 650 g, and containing pus. From that site, the abscess gradually tapered off toward the
190 umbilical region (Fig. 4B).
191 Histopathological examination revealed that the removed abscess was contiguous with the bladder
192 tissue by smooth muscle and connective tissue but did not communicate with the bladder. The abscess
193 was lined with transitional epithelial cells, similar to that in Case 1 and 2.
194 The final diagnosis was a urachal abscess extending from the urinary bladder to the inner region of
195 the umbilicus (Fig. 4C). As in Case 1, no particular complications were observed after surgery, and the
196 cow was successfully reintroduced into the producing herd.
197 The pus from the urachal abscesses of all the cases was aseptically collected and cultured on 5%

198 sheep blood agar under both aerobic and anaerobic conditions at 37°C for 48 h. The growing bacterial
199 colonies were subjected to mass spectrometric analysis using a matrix-assisted laser
200 desorption/ionization biotyper (Bruker Daltonik Inc., Billerica, MA, USA); the data obtained were
201 compared with the reference data from the MBT Compass Library to identify the bacterial species.
202 *Escherichia coli* was detected in Cases 1 and 2, while *Trueperella pyogenes* was detected in Cases 2 and
203 3. Drug susceptibility testing was performed in accordance with the protocol described by the Clinical
204 and Laboratory Standards Institute [6]. *E. coli* was found to be sensitive to cefazolin, kanamycin, and
205 enrofloxacin and resistant to penicillin and tetracycline. *T. pyogenes* was found to be sensitive to
206 penicillin, cefazolin, tetracycline, kanamycin, and enrofloxacin.
207 A urachal remnant can progress to an ascending infection, potentially leading to urachal abscesses,
208 cystitis, and pyogenic nephritis if treatment is delayed [3, 10, 11]. None of the cows in Cases 1 and 3
209 showed any outward signs of dysuria or other suspected signs of urachal abnormalities until adulthood.
210 The cow in Case 2 showed signs of dysuria at 4 months of age, but ultrasound performed at that time
211 showed no abnormalities in the umbilical cord in the abdominal cavity.
212 While several cases of bovine urachal abscesses have been reported [1, 8, 13, 15, 18-20], only few
213 reports of urachal cysts exist [5, 11, 12]. Most of these reports involve calves; to the best of our
214 knowledge, the present report is the first on cattle > 18 months of age.
215 For surgical intervention for urachal disease in calves and heifers, the median, paramedian, or
216 paralumbar fossa are typically considered for accessing pelvic cavity organs such as the urachus and
217 bladder.
218 Cesarean section is a surgical approach to accessing the pelvic cavity organs in adult cows. While
219 Cesarean sections are mainly performed through the paralumbar approach, alternatives include the
220 paramedian and ventrolateral approaches.

Compared to a paramedian incision, a ventrolateral incision easier extension of the incision line caudally, making it suitable for the removal of large emphysematous fetuses [14]. However, accessing these organs via the ventrolateral approach can be challenging due to the considerable distances to the pelvic cavity organs. For accessing small organs near the pelvic cavity, such as the bladder, the preinguinal approach, characterized by a more caudodorsal wound placement, presents an advantage over the ventrolateral approach in terms of operability.

Nevertheless, we found that this approach was difficult to implement in cases with severe adhesions between the urachal abscess and the surrounding areas such as the abdominal wall. Compared to that of the abdominal floor and the surrounding area, closure of the preinguinal region is often more difficult, given the greater tension placed on the muscle layers of the incision. The integrity of the abdominal wall closure in preinguinal approach is lower than that with the ventral median and paramedian approaches; thus, care must be taken to ensure suture closure, as it is prone to herniation [14]. In cases of urachal cysts in adult cattle, the ability to detach the adhesions from the surrounding areas and traction of the bladder to the incision wound have a significant impact on surgical success or failure.

In conclusion, the preinguinal approach proves effective in adult cattle with bladder and urachal disorders that are difficult to access through a median or paramedian incision. However, abscesses connected to the umbilical region necessitate a combination of median and paramedian incisions. This approach enables thorough dissection of the adhesions within the abdominal cavity and facilitates removal of urachal abscesses. Conversely, for urachal cysts lacking continuity with the umbilical region and not severe adhesion, removal can be addressed solely through the preinguinal approach.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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FIGURE LEGENDS

Fig. 1

Rectal ultrasonography image (A), intraoperative view of preinguinal surgical incision (B), removal of abscess containing pus (C), and illustration of intra-abdominal findings (D) in Case 1. The abscess (asterisk) is located at the tip of the bladder. Cr: cranial; Cd: caudal; BL: bladder

Fig. 2

Illustration showing holding position during surgery. All cattle are positioned in the right lateral recumbent position with the hind limbs held open. Dashed lines indicate incision lines with the preingunial approach.

Fig. 3

Rectal ultrasonography image (A), necropsy views (B), and illustration of intra-abdominal findings (C) in Case 2. The mass (asterisk) is located at the tip of the bladder. Cr: cranial; Cd: caudal; BL: bladder

Fig. 4

Rectal ultrasonography image (A), removal of abscess containing pus (B), and illustration of intra-abdominal findings (C) in Case 3. The abscess (asterisk) is located at the tip of the bladder, extending from the umbilicus to the bladder. Cr: cranial; Cd: caudal; BL: bladder; UM: umbilicus

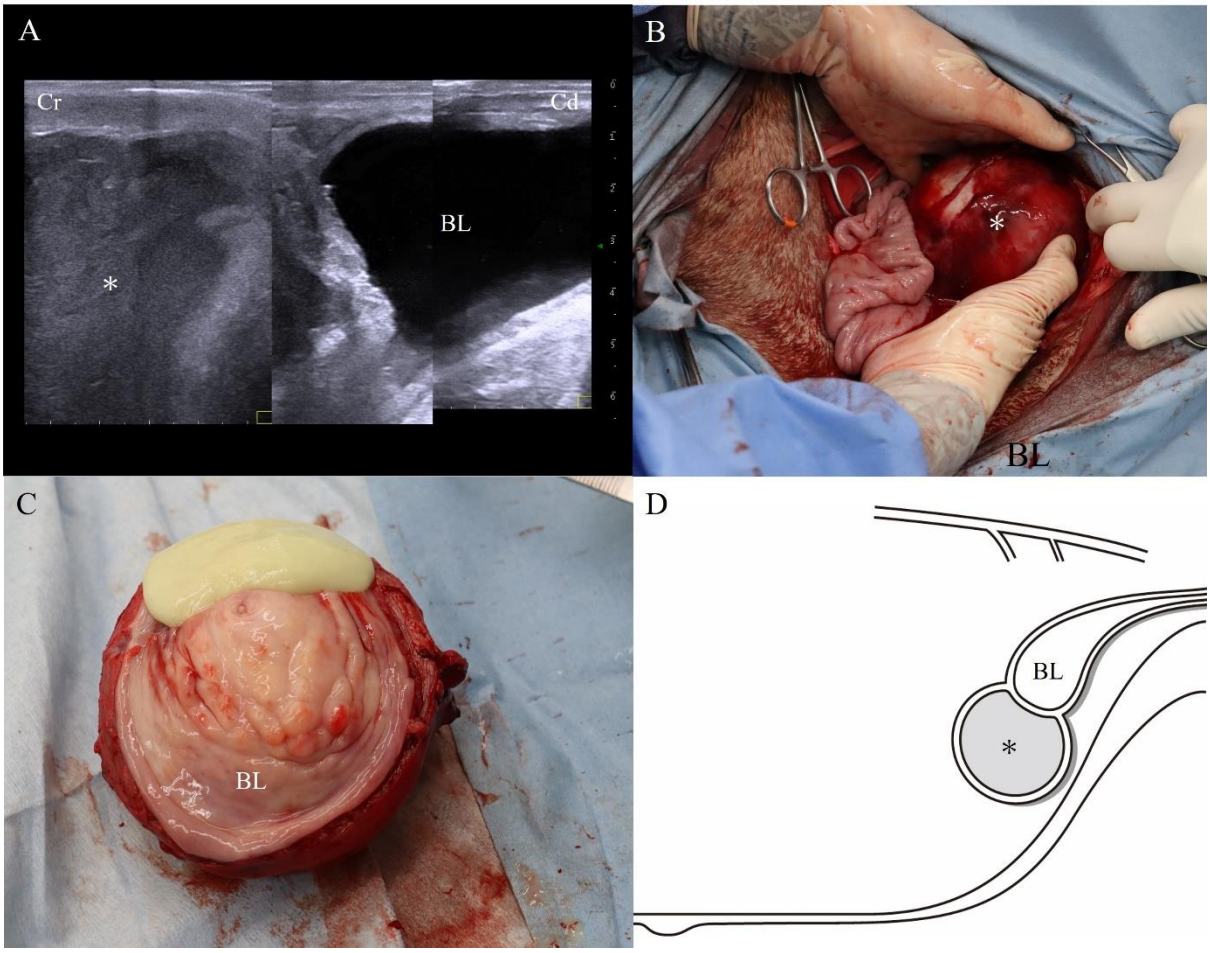

Fig. 1

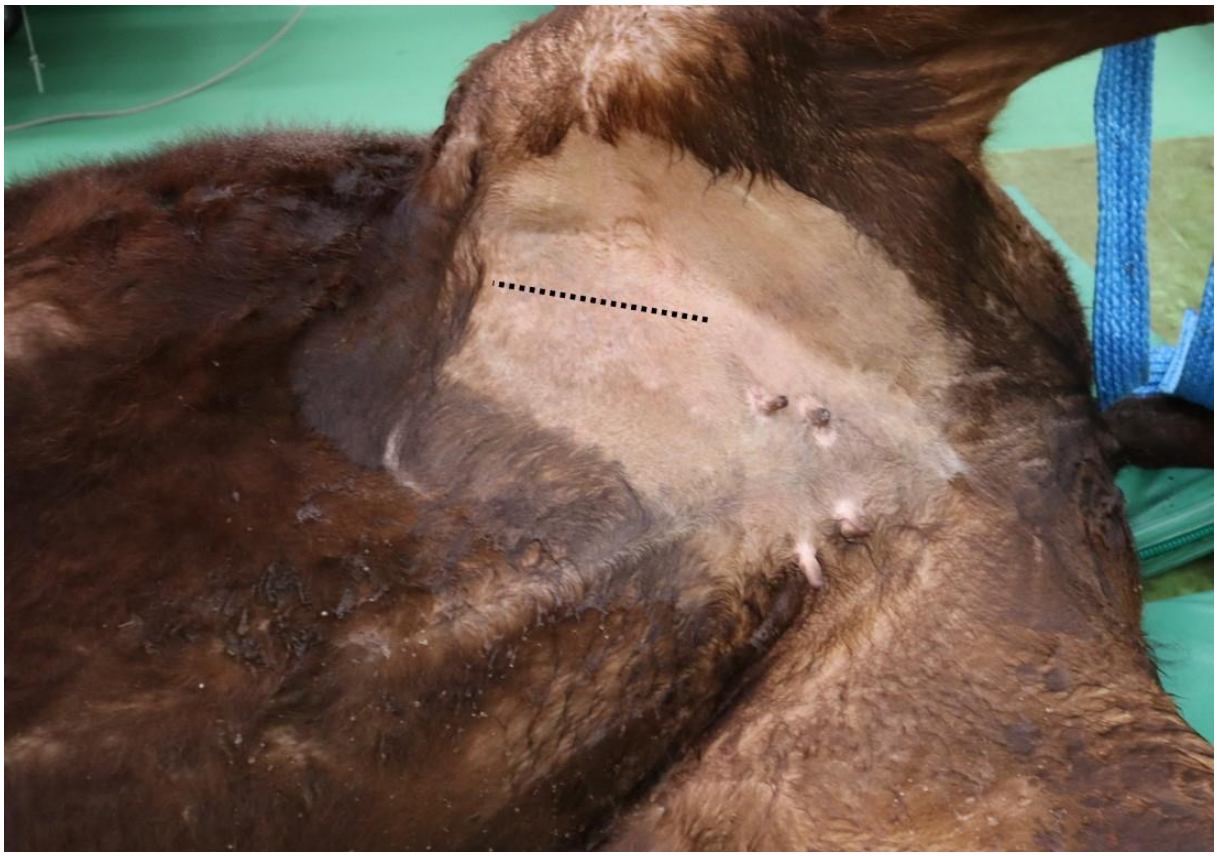

Fig. 2

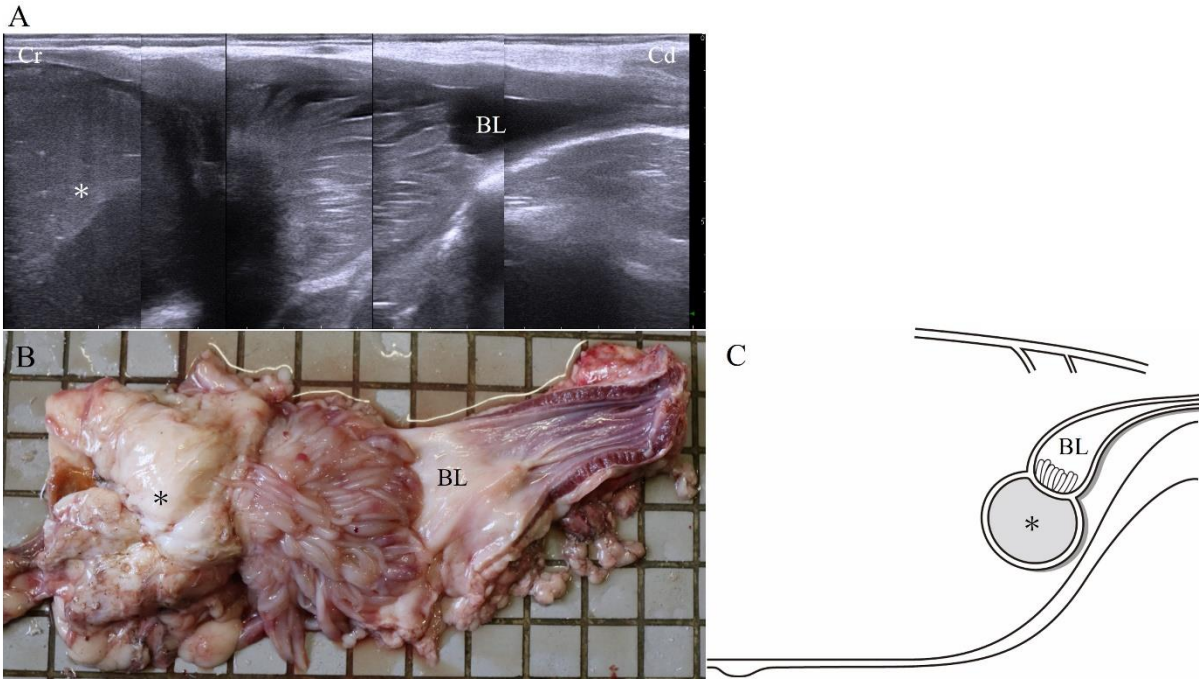

Fig. 3

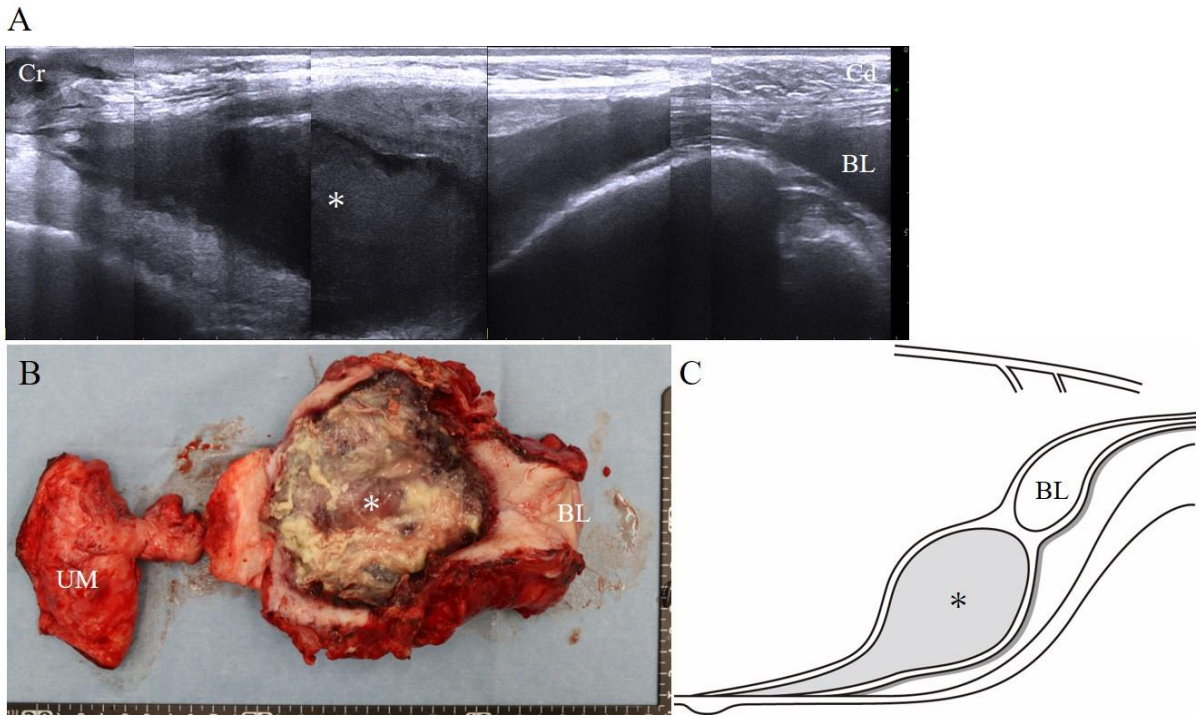

Fig. 4