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Diagnostic imaging of lateral abdominal fistulas in dogs

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Summary

Aim of the study. The study presents the application and effectiveness of ultrasound and radiological examinations in cases of fistulas located in the lumbar region.

Material and methods. Six spayed bitches of different big breeds were referred for radiological examination. In four dogs, the initial clinical examination revealed the presence of fistula in the sublumbar region. In two bitches, painful mass lesions were observed in the region of the lateral abdominal wall.

The ultrasonography examination of the abdominal wall and cavity was performed. In four females, radiographic examination was performed, which in two cases was extended to fistulography.

Results. The ultrasound examination revealed the presence of non-physiological areas in the abdominal cavity, caudally to both kidneys. They had reduced echogenicity, characteristic of hyperplastic inflammation. Ultrasound examination also revealed the presence of structures characteristic of foreign bodies. In four cases, the course of the fistula tract and secondary extensions were visualized. In one female, tumor lesions in the ovary area were connected with the caudal part of a kidney. In this kidney, features of urinary retention were also observed. In two bitches, an enlarged uterine stump was observed.

In the examined animals, the survey lateral abdominal radiograph did not reveal any pathological changes. Only in one animal, changes in the skeletal system were found. Radiographs performed in dorsal recumbency were differentiated between individual animals. Contrast examinations showed the course and secondary extensions of the fistula canal in both lateral and ventrodorsal projection. Lateral contrast radiographs revealed a significant spreading of fistula cavities and secondary extensions along the fascia lines of the abdominal wall.

Conclusions. Ultrasound examination plays an important role in the diagnosis of fistulas, making it possible to perform a detailed evaluation of parenchymal organs and infected soft tissues, as well as to identify foreign bodies. However, it cannot be effectively used for a precise evaluation of the size of changes and relationships between fistula cavities and canals. Fistulography seems to be the most reliable for this purpose.

Keywords: abdominal fistulas, fistolography, ovariohysterectomy

Fistulas or sinus tracts (draining tracts) are abnormal connections between body organs, body organs and cavities, or body organs and the skin. They can be either congenital or acquired (5). In veterinary literature there are many descriptions of congenital fistulas in the vascular system, as well as between abdominal and thoracic organs (3, 4, 9, 12, 17, 21, 22, 24). In animals, acquired fistulas are also described, mostly as a result of a chronic inflammatory process due to migration of foreign bodies (4, 5, 11). They have been described in areas such as the head, neck, foot pads, as well as the inguinal, gluteal, and lumbar regions (4, 5, 11, 14, 25).

Evaluation of the source and course of a fistula tract is very important for treatment decisions, and it is often a challenge for a veterinary surgeon (5). Correct diagnosis is based on precise clinical examination and on diagnostic imaging methods. The choice of imaging techniques depends on the type of tissues affected by the inflammatory process. A detailed evaluation of fistulas includes the location of their external and internal openings, the course of the primary tract, the presence of secondary extensions, and other diseases that may be a complication of the process (23).

This study compares the application and effectiveness of ultrasound and radiological examinations in cases of fistulas located in the lumbar region. This location is characteristic of foreign bodies in peritoneal or retroperitoneal cavities (4). In the present study, the

cause of fistulas in dogs was a non-absorbable surgical material used for ligation during ovariohysterectomy.

Material and methods

The animals (6 spayed bitches of different big breeds, aged 5-8 years) were referred to the Laboratory of Radiology and Ultrasonography for radiological examination by private clinics in 2008-2014. In four bitches, the initial clinical examination revealed the presence of one-sided fistula in the sublumbar region. The external openings of the fistulas were single with purulent discharge. In the remaining two bitches, painful mass lesions were observed on both sides in the region of fossa paralumbalis of the lateral abdominal wall. The masses, measuring 4-8 cm, were firmly connected to the muscles. In these cases it was not possible to find the external openings of the fistulas. One of the patients, a four-year-old Central Asian Shepherd Dog, with a fistula on the left side of the abdominal wall, underwent surgery three times before referral. After each surgery, the lesion reappeared in the same region.

Prior to imaging examinations, the animals were sedated with xylazine hydrochloride (20 mg/ml, 2 mg/kg mc im., Sedazin, Biowet Pulawy) and atropini sulfas (0.5 mg/ml, 0.05 mg/kg mc im., Atropinum Sulfuricum WZF, Polfa SA). In all cases, the ultrasound of the abdominal wall lesions and abdominal organs was carried out. Ultrasonography examination was performed with micro-convex (6.5-8.5 MHz) and linear probes (10-12 MHz). During the examination, the animals were positioned in sternal, lateral, and dorsal recumbency.

In four females, radiographic examination was performed, which in two cases was extended to fistulography. The radiographic study of the abdomen was obtained in lateral and dorsal recumbency. The evaluation included the visibility of serosal peritoneal details, the size and margins of abdominal organs and retroperitoneal space, the outline of the abdominal muscles, as well as the size, shape, and radiodensity of lumbar vertebra. Then, fistulography was performed. Fistula canals were cannulated and flushed with sterile saline introduced into fistulas. A positive iodinated non-ionic contrast agent (Visipaque, iodixanolum 320 mg I/ml) was administered by means of a catheter with a diameter of 0.8 × 1.3 mm. Subsequent radiographs were conducted in lateral and ventrodorsal views. In order to visualize better the course of fistulas, an increased portion of the contrast agent was given. The location of the external and internal openings, the course of the primary tract, the presence of secondary extensions, and other diseases that may have been a complication of the process were evaluated.

Results and discussion

In all cases of external fistulas, the ultrasound examination revealed the presence of non-physiological areas caudally to the kidney at the same side as the fistula

Tab. 1. Ultrasound evaluation of changes in the dogs

Dogs No.	Lesions in the ovarian area	Features of the fistula canal	Changes in the soft tissue of the abdominal wall	Lesions of the uterine stump	Other complications
1	On the left side – non-homogenous, diffuse, poorly demarcated masses, 5 cm in size, with increased echogenicity. Within the changed tissues, a curved hyperechogenic structure of 0.8 cm with a distal acoustic shadow was found	Fusiform, 1 cm in diameter, split at the external opening, recesses present	A significant amount of hyperechogenic, poorly demarcated tissues of mixed echogenicity	Not found	Not found
2	On the left side – poorly demarcated, irregular tissue masses, about 5.5 cm in size, with heterogeneously increased echogenicity. A double hyperechogenic structure, 0.8 cm long, with acoustic shadow was found inside	Elongated, hypoechogenic, with irregular edges, distended to 3 cm at the external opening recesses, secondary extensions present	Irregular, diffuse hyperechogenic areas alternate with hyperechogenic connective tissue. Lesions with features of chronic severe inflammation, gas shadows present	Not found	Not found
3	On the right side, poorly demarcated masses of mixed echogenicity. Small hyperechogenic foci with a poorly marked acoustic shadow were visualized	Irregularly hypoechogenic, oblique, 0.9 cm in diameter	Extensive, poorly demarcated hypoechogenic areas mixed with connective tissue	Not found	Not found
4	Bilateral lesions of 3 and 4 cm in size with irregular outline, heterogeneously decreased echogenicity, surrounded by connective tissue. In the center of the lesions there was a slightly curved hyperechogenic structure, 3-4 cm in size with a distal acoustic shadow	Narrow, hypoechogenic, reaching subcutaneous tissue, with secondary extensions	In subcutaneous tissue, poorly demarcated small areas of mixed echogenicity	Enlarged uterine stump (3.5 × 2.5 cm) with signs of inflammation (formation of the abscess)	Urinary retention in the renal pelvis, segmental ureter distension
5	Bilateral, hypoechogenic lesions of about 2 and 2.5 cm in size, irregular oval shape, surrounded by irregular hyperechogenic tissue. In the center of the lesions, there were oval hyperechogenic foci with an acoustic shadow	Poorly visible, single, asymmetrical, hypoechogenic	A small amount of hyperechogenic connective tissue, signs of inflammation in subcutaneous tissue, mostly on the right side	Not found	Not found
6	On the right side, lesion with a decreased echogenicity, irregular outline, surrounded by irregular hyperechogenic tissue. In the center of the lesion, there was a linear echo, 3-4 cm long with a distal acoustic shadow	Poorly visible, with heterogeneous echogenicity, 4 mm wide	Slightly hypo- and hyperechogenic areas with signs of inflammation in soft tissues	Enlargement of the uterine stump with signs of the abscess formation	Lumphadenopathy of the lumbar center

Fig. 1. Ultrasound image of the right ovarian area (dog No 5). The hyperechogenic slightly curved structure is a foreign body (arrows). The suture material was removed during surgery.

canal (dogs No 1, 2, 3, 6). In the case of dogs 4 and 5, ultrasonographic changes were located caudally to the kidneys, bilaterally (Tab. 1). In all cases, changed areas had a reduced echogenicity, characteristic of hyperplastic inflammation. In three dogs, lesions were irregular, poorly demarcated, with hyper- and hypoechogenic areas (dogs No 1, 2, 3). In these dogs, changes were also observed in tissues of the abdominal wall. Solid, soft tissue masses were diffuse, poorly demarcated with varying echogenicity. In the remaining bitches (No 4, 5, 6), lesions with low echogenicity were observed in the ovary areas. They were surrounded by irregular hyperechogenic tissue, characteristic of connective tissue. In these patients, lesions in tissues within the region of fossa paralumbalis were less extensive. They were poorly demarcated with differentiated and variable echogenicity, and with features of cellulitis. In all cases, sonography revealed the presence of structures characteristic of foreign bodies. They were mostly linear, slightly curved and hyperechogenic with visible acoustic shadow (Fig. 1). In four cases (No 1, 2, 3, 4), the ultrasound made it possible to evaluate the course of the fistula tract and to find secondary extensions in the adjacent soft tissues (Fig. 2).

In five animals, sonography did not reveal any pathological changes in the abdominal organs. In one female, tumor lesions in the ovary area were connected with the caudal part of a kidney (dog No 4). In this kidney, features of urinary retention were also observed. A significant distension of the ureter in the proximal part indicated ureteral occlusion (Fig. 3). In this bitch, an enlarged uterine stump was observed (3.5 × 2.5 cm) with hypoechogenic semiliquid content and with a hyperechogenic centre. An enlarged uterine stump and reactive lumbar aortic lymph nodes were also observed in another dog (No 6).

In the examined animals, survey abdominal radiograph did not reveal any changes in the size or shape of the peritoneal cavity and retroperitoneal space, or

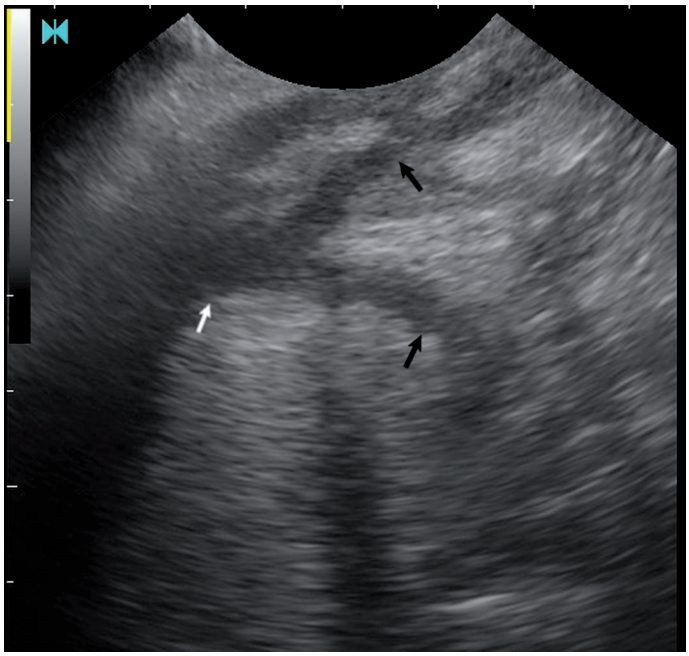

Fig. 2. Ultrasound image of fistula tracts in the soft tissues of the abdominal wall (dog No 1). The primary tract (white arrows) and the course of the secondary tracts are visible (black arrows).

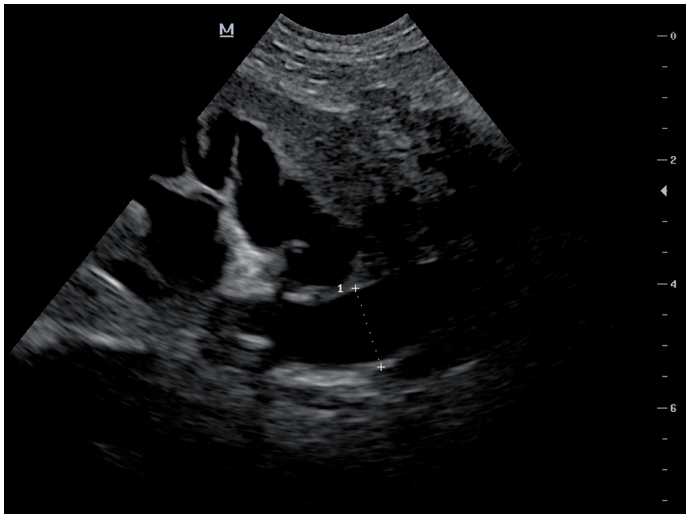

Fig. 3. Ultrasound image of the right kidney (dog No 4). Hydronephrosis development. Significant distension of the proximal ureter is visible. Intraoperatively, the kidney and proximal part of the ureter were found to be compressed by diffuse, inflammatory mass lesions.

changes in the size or shape of abdominal parenchymal organs. In one dog, the caudal outline of both kidneys was not distinctly seen. The caudal pole of the left kidney was ventrally displaced. No lesions that could have caused this displacement were visualized.

Radiographs performed in dorsal recumbency were differentiated between individual animals. Only in one bitch were the abdominal organs in their normal position. In this dog, the radiograph revealed two masses of similar radiodensity located caudally to kidneys. The lesions were different in size and shape. One lesion, located caudally to the right kidney, was oval in shape, and its dimensions were 5 × 3 cm. The opposite lesion

was round and had 3 cm in diameter. In the other dogs, a poorly defined area was visible in this location. Its size was similar in particular animals, ranging from 9 to 12 cm in length and from 5 to 6 cm in width. The area was always located caudally to the nearest kidney and caused displacement of intestines to the opposite side of the abdomen. In one bitch, the lesion caused displacement of the spleen from the abdominal wall. It was the case in which the outline of the abdominal wall was not distinctly visible. In all cases, the opacity of the area was non-homogenous, decreased in comparison with abdominal organs and slightly increased in comparison with fatty tissue.

Contrast examinations showed the course and secondary extensions of the fistula canal in both lateral and ventrodorsal projection. The fistula's tracts and cavities were irregular, but well demarcated. The presence of the contrast medium in the peritoneal cavity was not revealed in all cases. The ventrodorsal view showed the peripheral location of fistula cavities and canals, which formed a connection between them (Fig. 4). Spaces filled with the contrast medium reached from 4 to 7 cm into the abdominal cavity and were located about 2-4 cm away from the nearest kidney and intestines. There was no contact with the skeletal system, either.

Lateral contrast radiographs revealed a significant spreading of fistula cavities and secondary extensions along the fascia lines of the abdominal wall. The course of the primary tract was oblique in the ventrodorsal direction at the level of the 5^{th}-6^{th} lumbar vertebrae. Two or three large longitudinal cavities were connected to them. One of them was positioned caudally and one cranially to the main fistula canal. The caudal cavity was slightly below the cranial cavity. Cranial cavities were positioned horizontally, whereas the position of caudal cavities was different. In one bitch, the third narrow irregular cavity was located dorsally from the cranial cavity. Its highest point was at a height of ½ of the spinous process of the 5^{th} lumbar vertebra (Fig. 5). Only this animal showed changes in the skeletal system. A slightly periosteal reaction on the ventral border of its fourth lumbar vertebra was observed in the lateral radiographic view. In the remaining animals, the image of the lumbar vertebrae was normal.

The imaging examinations revealed that proliferative changes in the area of the previously removed ovaries were the probable cause of fistula formation. This diagnosis was confirmed intraoperatively in all dogs.

Ovariohysterectomy is one of the most frequently performed surgeries. Apart from numerous advantages related to the prevention and treatment of reproductive system diseases, there is also a risk of complications (4, 10). Besides the risk of intraoperative hemorrhage, disorders associated with the reproductive system may occur a long time after operation. They include urinary incontinence, development of granulomas, and inflammatory processes resulting from improper asepsis or the use of non-absorbable surgical suture (4, 10, 14).

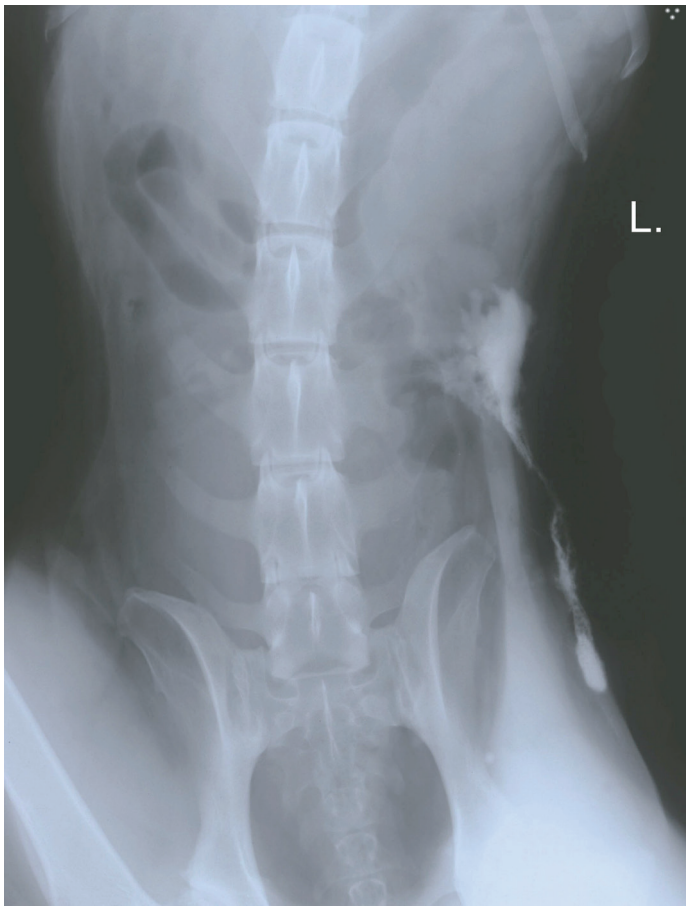

Fig. 4. Ventrodorsal view (contrast examination of the fistula tract). The location of fistula cavities and canals is shown.

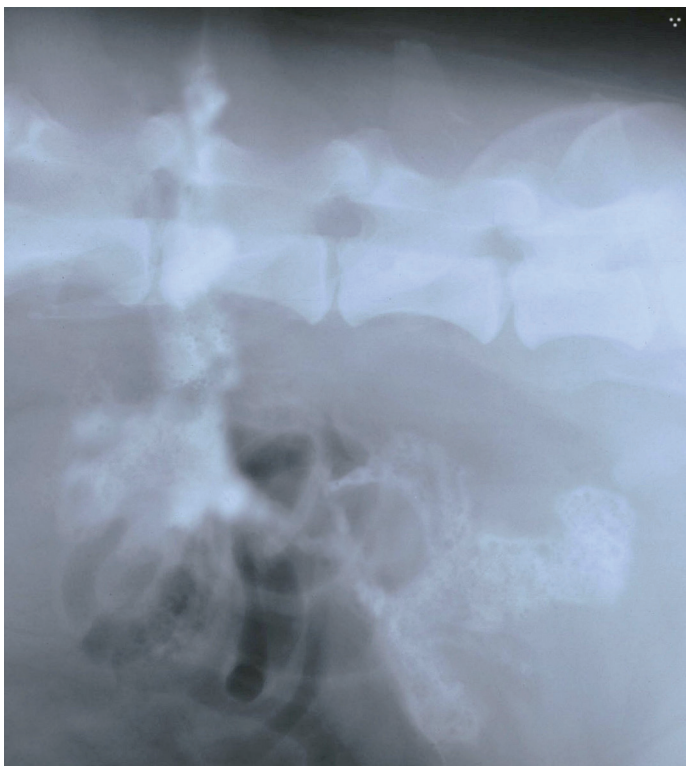

Fig. 5. A lateral contrast radiograph of another dog. The location, size, and number of cavities and the course of the fistula tract are shown.

A similar problem, probably related to complications after ovariohysterectomy, was also observed in the cases discussed here. Imaging examinations revealed extensive changes caudally to both kidneys in all dogs, which is the anatomical location of ovaries. In four bitches, fistulas were formed, with external openings on the skin in the lumbar region. In all animals, the probable etiological factor was the use of non-absorbable surgical sutures for ligation. The sutures gave a linear hyperechogenic image with a distal acoustic shadow, characteristic of a foreign body. Their presence was confirmed intraoperatively. Similar inflammatory responses to suture material were described in the lateral, femoral, and inguinal regions. In the development of fistulas, their source is located in the area of suture material, and they form a passage through the surrounding muscles to the skin (4, 14). Exudate due to a foreign body passes by the line of least resistance along the lumbar fascia to the skin (19). Granulomas of the ovarian pedicles, which cause the formation of fistulas due to nylon or other non-absorbable sutures, have been described in the literature (4, 14, 24). Such lesions may contribute to the formation of abscesses or granulomas in the retroperitoneal and peritoneal cavities including the kidneys, bladder, uterine stump, and pancreas (14, 24). Chronic fistulas due to retained surgical sponges have also been observed in the peritoneal cavity (4). Acquired fistulas have also been described as a complication of ovariohysterectomy, between the urinary bladder, peritoneal cavity and vagina, or as external fistulas with openings on the skin in the lumbar region (7, 18). Such fistulas usually form soft, painful swellings under the skin. Bloody or purulent discharge may be seen. In cases of antibiotic therapy, a temporary improvement may be observed (4, 20).

Diagnosis and treatment of fistulas are a great challenge for a veterinary surgeon (4). The literature suggests that the choice of the imaging technique depends on the type of affected tissues. Survey radiographs are usually not sufficient to make a full diagnosis. In the case of fistulas, the loss of serosal details may result from the surrounding inflammatory reaction and adhesions, tissue swelling, chronic periosteal reaction in the skeletal system, and the presence of gas opacities or foreign bodies in soft tissues (4, 16, 25). Similar lesions (the loss of the outline of the abdominal wall, periosteal reaction) were also observed in the cases discussed here, but they were not specific. In four dogs, radiographic examinations revealed the presence of a demarcated region caudally to both kidneys, as well as displacement of the adjacent abdominal organs. The location of the lesions could indicate the presence of a pathological process in the ovarian area.

Out of all imaging procedures carried out, the least informative were the survey radiographs of the abdominal cavity. Ventrodorsal radiographs visualized changes caudally to both kidneys, but it was not clear whether these changes were responsible for the displacement of abdominal organs. This area corresponded only partly to the cavities and fistula canals visualized in the contrast study. A poorly demarcated region was adjacent to the caudal borders of both kidneys and displaced intestines. There was no connection between contrast-filled spaces and the above-mentioned organs.

Fistulography makes it possible to conduct a detailed evaluation of fistulas and to determine the location of external and internal openings, the course of the fistula tract, and the presence of secondary extensions and other diseases complicating the process, as well as non-radiopaque foreign bodies (2, 14, 23). However, some authors report a low reliability of fistulography for small foreign bodies and when the fistula canal is not sufficiently filled with the contrast agent (2, 15). In cases of external fistulas and in suspicion of non-radiopaque foreign bodies, fistulography can be used to determine directly the source and course of the fistula tract. It is also possible to evaluate the extent of the disease process, the size and number of cavities, and their connection with other structures, including the skeletal system (8, 13, 14, 16, 19). The sensitivity and specificity of fistulography in detecting non-radiopaque foreign bodies amounts to about 87% and 100% (4). In humans, fistulography is effective in 17-25% of cases in identifying the internal opening of the fistula, and in 90% in determining its course. In 48% of cases, it is effective in evaluating additional pathological states caused by previous surgical treatment (1).

It should be admitted that a limitation of the present study was that bacteriological culture from the animals was not obtained, which would have made it possible to determine the character of lesions.

The inflammatory state was indicated by the ultrasound image of the changed areas, which was characterized by mixed echogenicity with predominance of hypoechogenic regions. The echostructure and echogenicity of the abdominal wall was altered. Another confirmation of the presence of fistulas and an inflammatory process in the changed areas came from the detection of foreign bodies and the fact that fistulas usually result from a chronic inflammatory state in the adjacent abscesses and infected tissues (2, 6, 11, 19, 20).

In two cases, the ultrasound examination revealed inflammatory lesions in both ovarian areas. Moreover, in two cases the ultrasound revealed features characteristic of uterine stump inflammation. In one case, during the scanning of abdominal organs, signs of hydronephrosis were found, which was caused by the compression of the kidney and the proximal part of the ureter by mass lesions. In all cases, ultrasonography made it possible to visualize foreign bodies that were not found in radiographs. In one case, gas opacities were observed near the changed area, which were invisible in survey radiographs, either. These results are consistent with those of other authors, who report that ultrasound examinations are effective in detect-

ing non-radiopaque foreign bodies and in evaluating fistula canals strictly associated with them (2, 15, 16, 20). These authors also show the usefulness of the ultrasound in determining the precise location of lesions, which is important for surgery planning (2, 16, 20).

A disadvantage of the ultrasound in the present study was that it was impossible to accurately evaluate fistula canals and recesses, the skeletal system, and the topographical relationship between abdominal organs. Before the examination, fistula canals were not purified from the purulent content and the cavities were not as large as in the contrast study. In cases of fistulas formed as a result of a migrating foreign body, the purulent content of the canal may, through increased echogenicity, entirely prevent the detection of the foreign body (20). Moreover, the foreign body may be misinterpreted when focal mineralization or bone fragments occur in the changed area (2).

A very precise method of imaging fistulas is the magnetic resonance technique. It is particularly useful in cases of numerous, complex and recurrent changes (19). This is due to the fact that the contrast examination does not always visualize the entire fistula tract, especially in acute cases, in which inflammatory granulomatosis obliterates the lumen of the tract (23). This examination, however, is as yet less available and more expensive than the radiograph or ultrasound examination. Similarly, computed tomography, which is particularly useful in the evaluation of abscesses and foreign bodies, is not easily available (14).

Ultrasound examination is important in the diagnosis of fistulas. It can be used for a detailed evaluation of parenchymal organs and infected soft tissues, as well as for the identification of foreign bodies. It is, however, ineffective in evaluating precisely the size of lesions, as well as the shape of and relationships between fistula cavities and canals, particularly when secondary extensions are filled with dense content or when they are located at greater depths. For such purposes, fistulography seems to be the most reliable.

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