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Graphically x-ray and ultrasound diagnostics for monitnoring neoplasia of the mammary gland in bitches

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The article deals with the results of clinical, X-ray and sonographic examination of 127 bitches of different breeds aged from 5 to 16 years, which over the years of 2006-2015 were coming into the clinic of small animals of LNUVMB named after S.Z. Gzhytskyj with neoplasia of mammary gland. According to the initial examination of animals the clinical signs typical for mammary gland tumors were found in 102 (80.3%) dogs. According to the criteria of international clinical TNM classification in 44 (43.14%) bitches was detected the first stage of tumor process (T1aN0M0, T1aN1aM0), in 25 (24.51 %) – in II (T1bN1aM0, T1bN1bM0, T1b, c N1aM0, T1b,c N1bM0, T2aN0M0, T2bN0M0, T2bN1aM0, T2b,c N1aM0), in 29 (28.43 %) – III (T1b,c N2bM0, T2b,cN1bM0, T3aN1aM0, T3bN1bM0, T3b,c N1aM0, T3b,c N1bM0) and in 4 (3.92 %) – IV (T3b,c N1bM1, T3b,c N2bM1) the stage of tumors. In 25 (19.7 %) from 127 dogs, signs of neoplasia were expressed unclearly. Roentgen graphically in 58 (45.7%) of dogs with the II, III, and IV stage of tumors it was found out the local structural changes, indicating the location, size and shape of neoplasia and their relationship to the surrounding tissues; distant metastases in the lungs and liver were detected in 4 animals. According to 69 animals research the obtained results were less informative because of not clear or doubtful for visualization of X-ray structural changes typical for neoplasia. In 95.27 % of studied bitches by ultrasound examination MR it was carried out differential diagnosis of fibrocystic mastitis, benign and malignant neoplasms. Summarizing the results of clinical, X-ray and sonographic investigations you can see that integrated mutually complementary interpretation of obtained data is weighty argument for the identification of intractable lesions, diagnosis and monitoring of mammary gland tumors in bitches during preoperative examination.

Key words: dogs; neoplasia; distribution; mammary gland; TNM classification of tumors; radiological and son graphic method of investigation

Introduction

According to the researchers (Morris and Dobson, 2003; Cullen et al., 2008; Vascellari et al., 2009; Bronden et al., 2010), among various species of animals, dogs often suffer from neoplasia. Within the structure of oncological diseases of these animals a leading position (25-43%) is taken by mammary gland tumors (MR) (MacEwen and Withrow, 1996; Misdorp and Meuten, 2002; Hildebrand and Dzimira, 2006; Polton, 2009; Sleeckx et al., 2011).

MR neoplasia marked not only with the most prevalent, but a large number of nosological forms with a large variety of pathologies both in terms of localization, stage and nature of the pathological process and clinical display of the disease (Egenvall et al., 2005; Mouser et al., 2010; Matos et al., 2012).

A large variety and specific features of tumors in bitches, are mostly caused by combined course of tumor process with inflammation, hyperplasia or fibrocystic changes (Potoc'kyj and Shestjajeva, 2004; Shestjajeva, 2011), making extremely difficult the identification and differential diagnosis of neoplasia.

In such cases for getting full and objective information concerning the nature of the pathological process and nosological verification of disease it is necessary to use many laboratory and instrumental, including, special methods of examination (computer, magnetic resonance or positron emission tomography or scintigraphy). The latter are characterized by a high diagnostic informativeness, but are rather cost and are not always available in small hospitals (Vlasenko et al., 2010). Under such circumstances radiological and ultrasonographical methods are noteworthy which in human medicine are included in the

scheme of investigations for the MR differentiation of cancer in women. These methods are provided for in the scheme of complex examination of cancer patients of animals, because they together with clinical research are the basis for the classification of tumors by system TNM (Smith, 2008; Mysak, 2010). Simultaneously in the available literature it is not always possible to find an enough information concerning the application of X-ray and ultrasonic methods of research and their effectiveness on the recognition of certain pathologies MR in dogs, including neoplasia.

The purpose of investigations was to investigate clinical and morphological characteristics of tumors MR according to international TNM classification, installation of X-ray and son graphic criteria on clarifying nature of the pathological process, their interpretation and conducting differential diagnosis of neoplastic diseases during preoperative MR examination of dogs.

Material and methods

Researches were carried out in the clinic of small animals of LNUVMB named after S.Z. Gzhytskyj during 2006-2015 years. 127 bitches aged 5-16 (8.5) years of different breeds were the object of the research with single and multiple tumor lesions MR. In view of the considerable polymorphism of spontaneous tumors MR, during the initial examination of sick animals by tumors classification was carried out in accordance with international clinical TNM systematic L.N. Owen (1980) (Owen, 1980). For determining the clinical stage of tumors MR it was taken into acc*ount the size of the primary tumor T (tumor), the status of regional lymph node N (nodulus), remote metastases M (metastasis) and the results of radiological and sonographic studies.

X-ray examination area of the tumor lesion and chest, and if necessary also other body part (Abdominal organs or the skeleton) was performed using X-ray apparatus "Philips" and "ZooMax LC" in two standard mutually perpendicular projections.

Ultrasound research was performed by means of devices "ESAOTEMyLab 40" and "Aloka-900" for using convex sensor in B-mode at a frequency of 5.0-7.5 mHz at different depths. Directly neoplasia itself, a mammary gland parenchyma and surrounding tissue, regional lymph nodes, and for the purpose of detection of distant metastases, organs of the abdominal and pelvic cavities were subjected to sonographic research.

Results and Discussion

It is established that during the examination of 127 bitches with lesions MR, in 102 (80.3 %) clinical signs of neoplasia was no doubt, while in 25 (19.7 %) animal tumors signs were not clearly visible, as to the forefront were symptoms, that could indicate the inflammatory character of the pathology or on the suspicion of MR in pretumor process.

The impartial data on diagnosis in 102 dogs were obtained thanks to clinical criteria (TNM) classification of tumors. Based on the latter, it was carried out the clarifying of the frequency and localization of aplastic lesions MR (Table 1), recognized symptoms, are inherent to tumor growth, and are installed clinical stage and anatomical dissemination of tumor process. For initial animals' examination it was found 168 neoplasms, which in 72 (70.6 %) cases are classified as single, and in 30 (29.4 %) - multiple lesions. Tumors were most often located in the inguinal (41.07 %) and caudal abdominal (32.73 %) packages MR, rarely - in the cranial abdominal – 16,65 % and caudal pectoral - 6,54% and only in 2.97 % cases in the cranial pectoral MR. Left and right MZ were affected with almost equal frequency; tumor primarily that are localized in individual packages of one of the parties and less - bilaterally.

According to the criteria of international clinical TNM classification (Table. 1) in 43.14 % animals of 102 dogs it was installed the first stage of tumor process development (T1aN0M0, T1aN1aM0), in 24.51 % – II (T1bN1aM0, T1bN1bM0, T1b,c N1aM0, T1b,c N1bM0, T2aN0M0, T2bN0M0, T2bN1aM0, T2b,c N1aM0), in 28,43 % – III (T1b,c N2bM0, T2b,c N1bM0, T3aN1aM0, T3bN1bM0, T3b,c N1aM0, T3b,cN1bM0) and in3,92 % dogs – IV (T3b,c N1bM1, T3b,c N2bM1) the stage of tumors.

Table 1. Classification of breast tumors of dogs on the TNM system

Stage of tumor	T	N	M	Number of animals	%
1	T1a(44)	N0(40), N1a(4)	M0	44	43.14
	T1b, in(1)	N1b	M0	1	0.98
2	T1a(1), T1b(4), T1b,in(3)	N1a(6), N1b(2)	M0	8	7.84
	T2a(2), T2b(12), T2b,in(2)	N0(3), N1a(13)	M0	16	15.7
3	T1b,in(1),T2b,in(4)	N1b(4), N2b(1)	M0	5	4.9
	T3a(2), T3b(3), T3b,in(19)	N1a(8), N1b(16)	M0	24	23.52
4	T3b,in(4)	N1b(3), N2b(1)	M1(4)	4	3.92

For visual examination it was established that spontaneous tumor MR in form, usually round or ellipse, in size - from small peas (0.5-1 cm) to the size of a man fist and more. When palpation is not painful, knotted, tightly elastic, less of soft consistency with a smooth or hilly surface. Small neoplasm (3 cm in greatest dimension T1), located in the thickness of the parenchyma and had a view of clearly limited, slightly less contouring knotted seals, while most tumors, the size of 3-5 cm (T2) seized a large part of the organ. Because of anatomical localization within the gland, neoplasms are clearly contoured, that creates the appearance of a pseudo incapsulated. In some dogs, tumors maintain mobility concerning surrounding tissues, sometimes even with quite

large size. However, neoplasia with value of more than 5 cm (T3) and tumors of gigantic proportions, in all cases were fixed with the surrounding tissue, and above all, with skin.

Quite often there was the inflammatory process both in the tumor and the surrounding tissue; in such cases, on the surface of new formations it was detected ulcers, fistulas and serous or bloody discharge from the nipple of the affected MR.

Studying of morph functional reorganization process MR and structural changes, caused by the emergence and the development of new formations showed that for their evaluation there is a need for a comprehensive interpretation of clinical data, X-ray and sonography, ie the need for comparison or complementary interpretation (Mysak and Pritsak, 2011).

As shown by the analysis of radiographic research of 69 animals on admission to the clinic, obtained results were less informative because of not enough clear or doubtful visualization on X-ray of structural changes characteristic for neoplasia.

At the same time, in 58 dogs with II, III and IV stage of tumors (defined according to clinical criteria TNM) it was established X-ray local structural changes, pointing to location, size and shape of neoplasia and their connection with the surrounding tissue; in 4 animals it was detected remote metastases in the lungs and liver.

So, lesions in dogs with cranial thoracic MR (Figure 1) tumor was presented homogeneous shadow which, having no clear boundaries, occupied the entire body parenchyma and regional lymph nodes; multiple metastases were in the chest cavity, that there is direct evidence of malignant tumors.

**Fig. 1.** X-ray of mammary gland and the chest cavity. (Dachshund "Berta" age 11, malignant tumor T3bcN1bM1)

According to various lesions manifestations of MR it was found some characteristic features of local pathological process. Invasive tumors were visualized, mostly, the shadow without clear contours of shadow rays, that permeate the gland and surrounding tissue. Mastopathy is characterized by diffuse weakly expressed shadow with strands and plots of lower density, that testifies to presence of cystic formations; calcifications on the background of mastitis indicate malignancy pathology.

In cases of fibroadenomas it was noted clear outlines of shadows, which limits tumors, and strands and plot of enlightenment in the presence of tumor process with mastopathy or inflammation.

Practice has shown that indication for radiographic examination of the chest, abdomen, skeleton is the result of clinical examination and detection of pathognomonic (specific) symptoms, which may indicate the probability of metastasis of the primary tumor in distant organs most frequently in the lung, liver, bones (MacEwen and Withrow, 1996; Misdorp and Meuten, 2002; Hildebrand and Dzimira, 2006).

However, to detect on radiographs the initial focuses of metastases (magnitude 0.5 cm) practically are not possible and only when they reach the larger sizes are visualized rounded, usually multiple and often isolated foci (Fig. 2).

Based on X-ray examinations conducted with certain periods of time, it was found out that the development of metastases is quite aggressive process, because none of the investigated animals from the moment of the detection the metastasis in the absence of treatment survive the period of 60 days (48 ± 11.5).
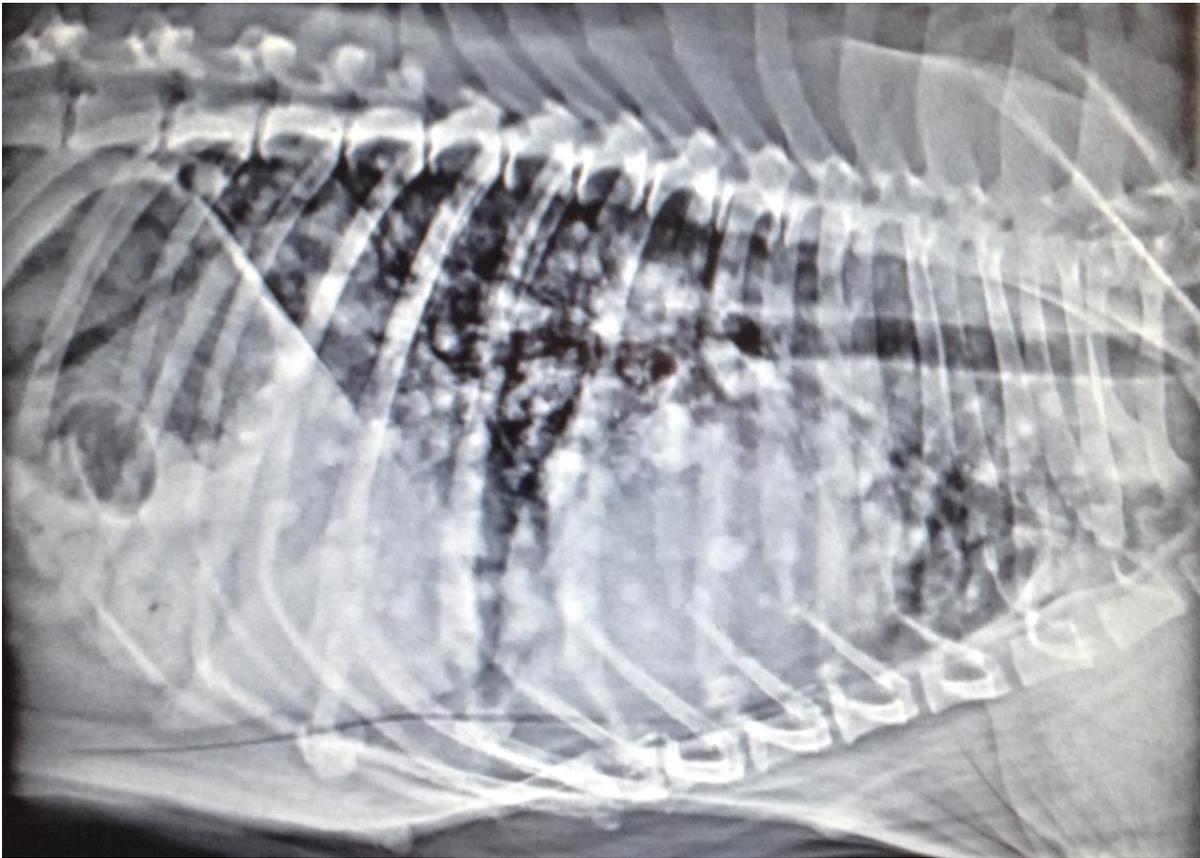
Fig. 2. Multiple metastases of malignant tumors of the chest cavity. Fox Terrier "Kasia" age of 8 years

About invasiveness and the number of metastases in lung tissue, and also such lesions compatible with animals' life can be seen in pathological anatomy pictures presented in Figure 3.
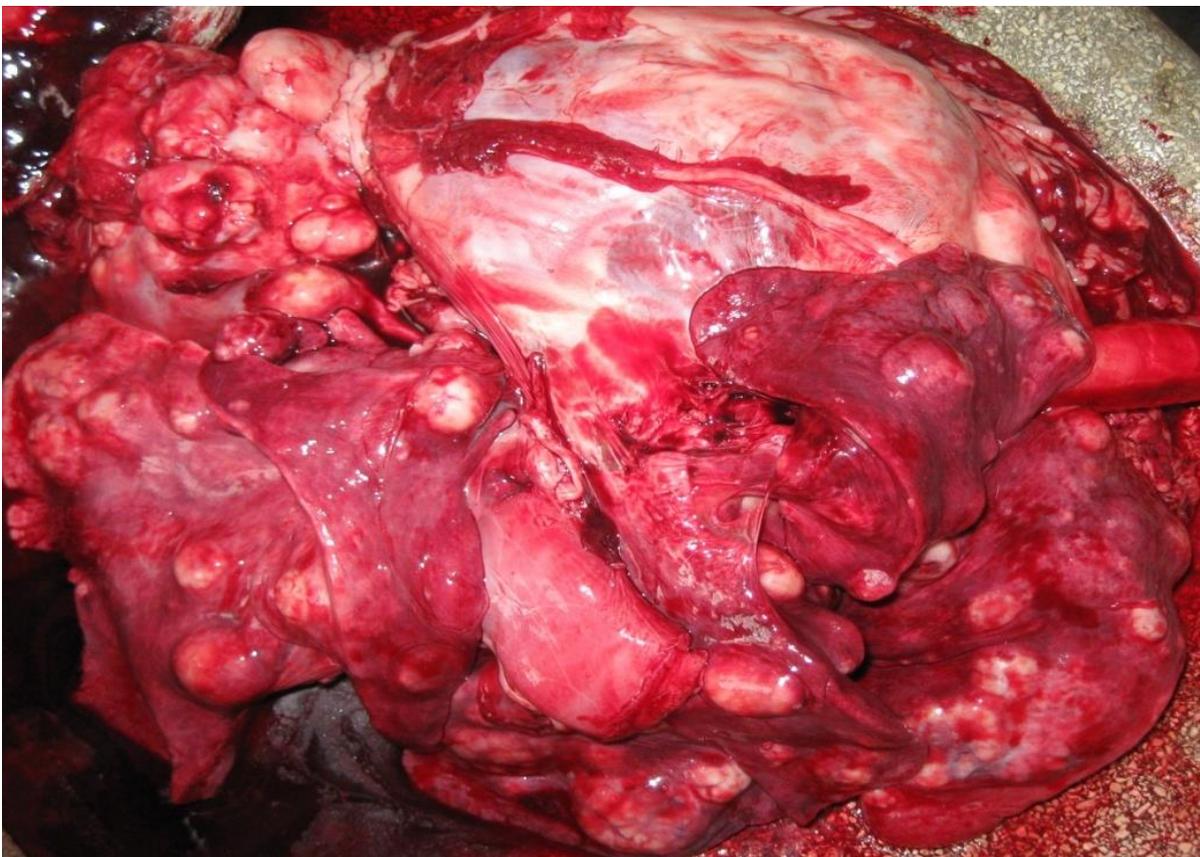
Fig. 3. Multiple metastases of malignant tumors in the lung (Posthumous lungs macropreparations)

During the examination of dogs, along with radiographic, it was also applied ultrasonographical examination. Based on ultrasound examinations MR in bitches and their analysis it was highlighted many criteria of sonographic echogenicity of tissues, which have allowed to establish nature of the flow of some pathological processes in MR. So, by sonography in bitches aged over 5 years are often observed echo graphic signs of MR diffusion fiber adenomatosis (fibrocystic mastitis). Based on sonographic pictures of detected structural defects between glandular, connective tissue and fat components of MR, it was defined:

- fiber adenomatosis with a predominance of glandular component (parenchyma in multiple hypoechoic structures by expanding channels and poorly expressed signs of fatty involution);
- fiber adenomatosis with a predominance of fibrous component (relative increase of thickness and a significant increase in echogenicity of the parenchyma MR);
- fiber adenomatosis with a predominance of cystic component (rounded anxiogene formation with signs of cysts on the background of the changed structure of the parenchyma).

However, as shown by the analysis of sonographic examinations, most often the mixed form of fiber adenomatosis was noted in the investigated animals, in which simultaneously are visualized all of the above-mentioned features by some dominance fibrocystic changes.

Ultrasound semiotics of simple cysts is characterized by the detection of aneho gene rounded formation with thin walls and the presence of distal strengthening of the echo signals and symmetrical lateral acoustic shadows (Fig. 4). Simple cysts are mostly multiple and of different sizes (0.3-5 cm).

In 42.5% of investigated bitches, fibromatous nodes visualization of different sizes was echo graphic feature of fiber adenomatosis, which is typical for a localized form of mastitis. It was observed (Potoc'kyj and Shestjajeva, 2004; Shestjajeva, 2011) that a diffuse form of fiber adenomatosis is the initial manifestation, which, due to the frequent complication of inflammation, mostly, is completed by the formation of localized nodes and their subsequent malignancy.
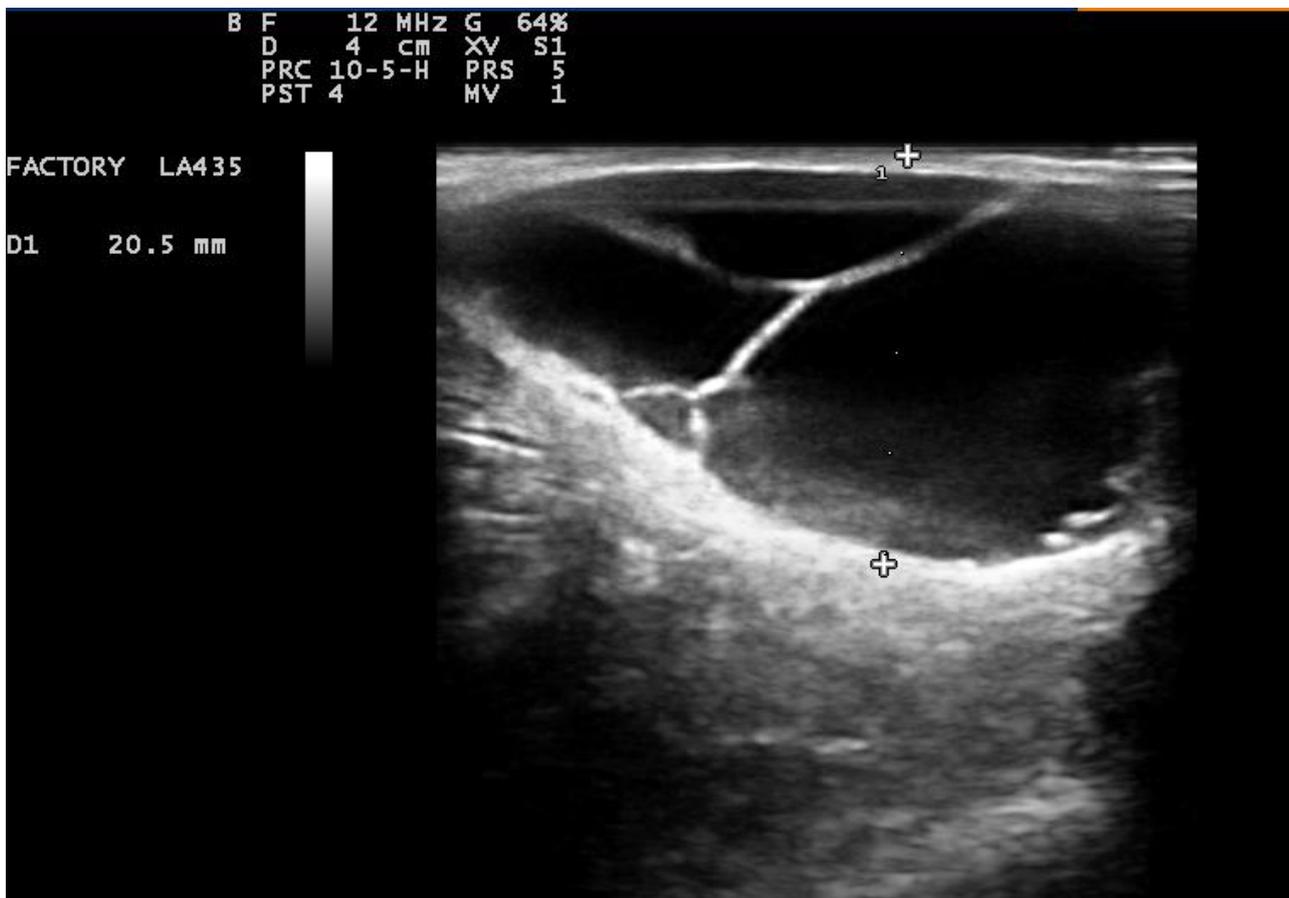

Fig. 4. Echo gram of cystic forms of fiber adenomatosis MR

Based on a comparative analysis of clinical research and data of ultrasound survey MR it was set up several echo graphic criteria which with a high degree of probability indicate a benign or malignant nature of neoplasm. Specifically, by benign neoplasm of echo structure of surrounding tissue is not changed. Echo graphic picture of round or oval tumor is much less of irregular shape, contours are smooth clear, the internal structure is hypoechoic, frequently homogeneous.

The heterogeneity may be caused by hyper echoic calcinates, less - linear fibrous inclusions. Benign creation can produce acoustic effects (distal strengthening of echo signal, less - lateral acoustic shadows).

Among the benign neoplasm MR in bitches mixed fiber epithelial tumors are the most prevalent, namely fibro adenoma and adenofibroma. Echographic picture of these neoplasia (Fig. 5) visualized as node creation of oval form against a background of

unchanged parenchyma MR. The longitudinal axis of neoplasm is oriented in parallel with the sensor, and the horizontal diameter exceeds vertical; an accurate contour throughout with the presence of a slight gain, homogeneous internal echoes and acoustic effects as distal strengthening and lateral acoustic shadows, good mobility, thin hyper echoic capsule, the lack of vascularization or periocular blood flow in neoplasm.
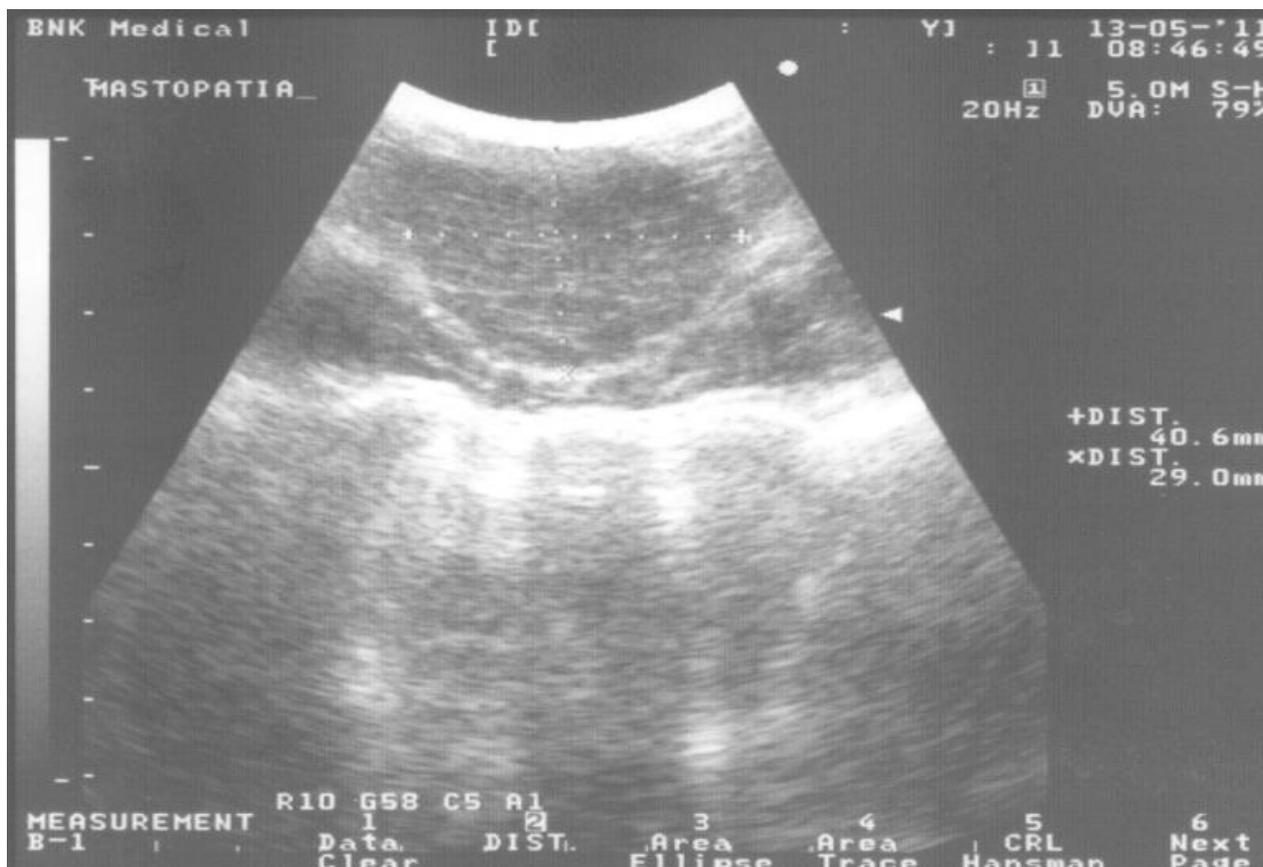
Fig. 5. Echographic picture of fibroadenoma MR

It is established that the process of tumor "aging" is accompanied by increased of fibrosis. In accordance with sonographic picture can be characterized by lack of contours clarity, heterogeneity of internal echo signals, the availability of full or partial shade behind the formation.

In some animals, during the investigation of long-standing fibroadenomas it was detected Petrificus areas in the form of hyper echoic inclusions, as well as the areas of necrosis or purulent fusion in the form of hypo echoic formations which may testify neoplasia entry of malignant nature. In these cases, the research of regional lymph nodes is important, as increasing of their quantities, heterogeneity of echo structure and growth of the surrounding tissue are signs of metastatic changes, testifying the extra nodular spreading of malignant tumor.

So, in 25 bitches it was set up spreading of neoplastic process of regional lymph nodes, and in one - distant metastasis focus in the abdomen. In assessing echo graphic picture of aplastic lesions MR it was noted that in relation to the surrounding tissues the growth of tumors can be expansive or infiltrating. And if the first is a typical sign for benign tumors, then malignant both types of growth can be detected.

The visualization of large node with clear smooth contours against the backdrop of a thickening of the skin changed and subcutaneous tissue, heterogeneous internal echo structure, intense vascularization, the degree of acoustic shadow (Fig. 6) is characterized with expansive growth for tumors.

By infiltrating growth against the background of surface inflammatory changes, it was marked thickening of the skin, enlargement of lymph vessels; neoplasms of lowered echogenicity, with indistinct contours and heterogeneous echo structure; significant intra nodular vascularization, foci of calcification; phenomenon of distal strengthening and acoustic shadows, the presence of structural changes in the surrounding tissues (Fig. 7).

Fig. 6. Echo gram of malignant tumor with expansive type of growth
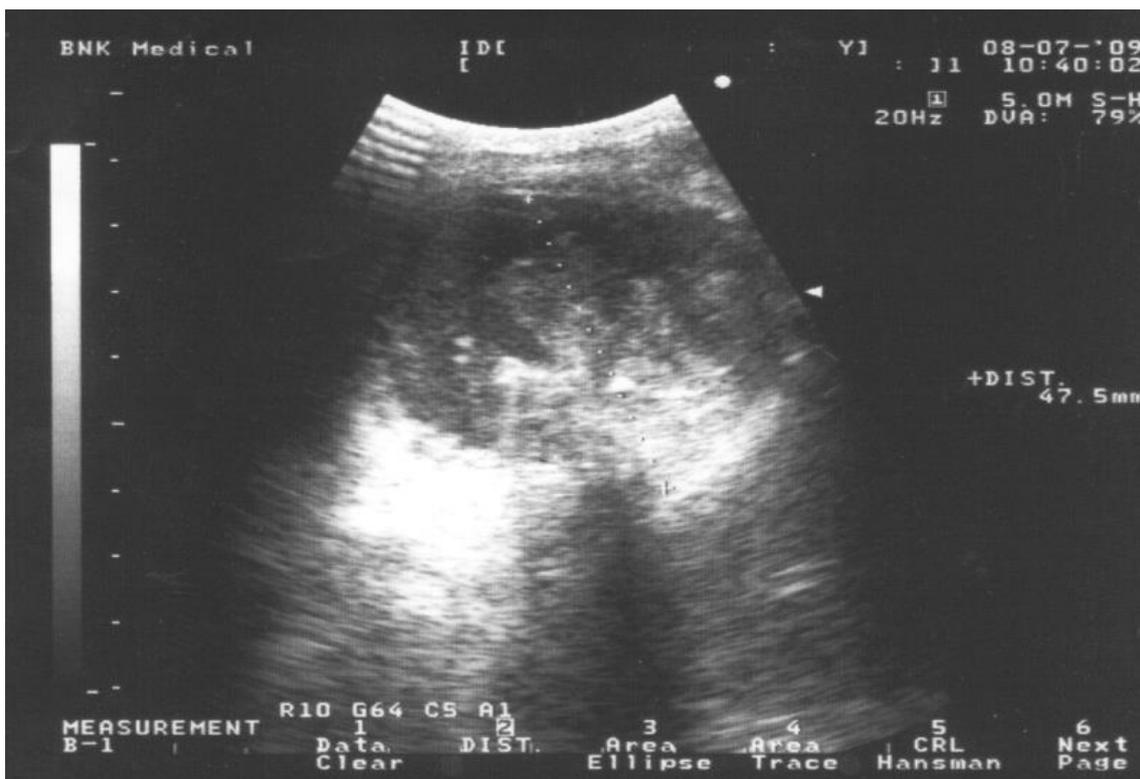

Fig. 7. Echo gram of malignant tumor with the infiltrating type of growth

So, in the study of the results of clinical, radiographic and ultrasound search it was set up they have screening values by differentiating MR neoplasia in dogs during preoperative clinical examination. Diagnostic perspective of each application is based on the identification of several criteria, visualization of which are in the process of the research and became a serious argument in the identification of structural changes in tissues MR for the display of fibrocystic mastitis, as a cancer risk factor MR and differential diagnosis of benign and malignant neoplasms. These methods cannot substitute each other, because for the final diagnosis and planning of further tactic of realization, necessary volume of remedial measures, a comprehensive interpretation of obtained data that is, their comparison or complementary interpretation is important.

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