Characterization of Malignant Canine Mammary Tumours Using B-Mode Ultrasonography

Devarathnam Jetty[1]*, Suresh Kumar RV[2], Bharathi S[3], Anand Kumar A[4] and Jagapathi Ramayya P[5]

[1]Department of Veterinary Surgery and Radiology, College of Veterinary Science, Proddatur, Andhra Pradesh, India

[2]Department of Veterinary Surgery and Radiology, College of Veterinary Science, Tirupati, Andhra Pradesh, India

[3]Department of Veterinary Clinical Complex, College of Veterinary Science, Tirupati, Andhra Pradesh, India

[4]Department of Veterinary Pathology, College of Veterinary Science, Tirupati, Andhra Pradesh, India

[5]Department of Veterinary Anatomy, College of Veterinary Science, Tirupati, Andhra Pradesh, India

Abstract

The present study was carried out to study the ultrasonographical characteristics of malignant canine mammary tumors. In ultrasonographic studies performed on 36 animals with malignant mammary tumors, 26 cases (72.22%) showed indistinct margins whereas in remaining ten cases (27.78%), the margins were circumscribed. All tumors showed heterogenous parenchymal echotexture, in which ten cases showed cystic spaces (anechoic areas) in parenchyma and remaining cases showed mixed echogenecity throughout parenchyma A hyperechogenic line delimiting the neoplastic tissue from the healthy tissue was observed around the tumor in 26 cases.

Keywords: Canine mammary tumours • Malignancy • B-mode

Introduction

Early diagnosis of malignant tumors is normally done by cytology and histopathology. Even though these are invasive procedures, the definitive diagnosis of the tumor makes them inevitable in every diagnostic plan of neoplastic conditions. Recently several non-invasive procedures were investigated to arrive at an early diagnosis of maliganancy, one of such procedures is diagnostic ultrasound. Ultrasonography has become an important tool in neoplasm evaluation and, when combined with mammography, can aid in the diagnosis, differentiation and prediction of malignancy in mammary tumors in human medicine [1]. Therefore, the present study was carried out to study the ultrasonographic characteristics of malignant canine mammary tumors.

Case Presentation

The work was undertaken on clinical cases of canine mammary tumors, which were brought to Veterinary Clinical complex and Department of Veterinary Surgery and Radiology, College of Veterinary Science, Proddatur during the period of 2017-2019. The research protocol was approved by Institutional Animal Ethics Committee vide reference no. 281/go/ReBi/S/2000/CPCSEA/CVSc TPTY/027/surgery/ 2018-19 dated 09.10.2018. After initial assessment of size, consistency and ulceration fine needle aspiration cytology was performed in all cases to rule out malignancy.

B-mode ultrasonography

The scanning procedure was performed in all malignant cases using diagnostic ultrasound with both convex (5 MHz) and linear (7.5 MHz) probes. 5 MHz convex probe was used to evaluate the volume, echotexture, margins and presence of anechoic areas using B-mode. Tumors were scanned both in longitudinal and transverse views. Margins of the tumors were classified as circumscribed or indistinct depending on whether the margin between the tumor and surrounding normal tissue was distinct or not. If no distinct margins were observed, the tumor was considered invasive. A capsule was considered present when a hyperechogenic line was visible around the tumor. Echotexture was classified as homogeneous when dots size and spacing is uniform or regular or heterogeneous when dots size is nonuniform or irregular.

Results

A total of 36 malignant canine mammary tumours cases included in the present study which were subjected to B-mode ultrasonography studies. All the 36 cases of mammary tumors in the present study were subjected to conventional diagnostic ultrasound using 5 MHz convex probe. The results are tabulated in Table 1.

Table 1. B-mode ultrasonographic characteristics of canine malignant mammary tumors.

| Ultrasound parameter	Types	No. of cases (n=36)
Margins	Circumscribed	26 (72.22%)
	Indistinct	10 (27.78%)
Capsule	Present	26 (72.22%)
	Absent	10 (27.78%)
Echotexture	Homogenous	0 (0%)
	Heterogenous	36 (100%)
Heterogenous echotexture	Anechoic areas	10 (27.78%)
	Mixed echogenecity	26 (72.22%)

Margins

Among the 36 tumors scanned, 26 cases (72.22%) showed indistinct margins (Figure 1) whereas in remaining 10 cases (27.78%), the margins were circumscribed (Figures 2 and 3).

Figure 1. B-mode ultrasonographic image of canine mammary malignant tumor showing indistinct margins and acoustic shadowing.
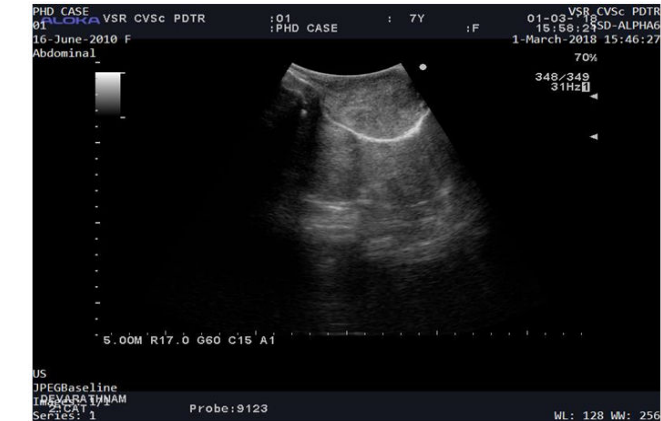
Figure 2. B-mode ultrasonographic image of canine mammary malignant tumor showing circumscribed margins.
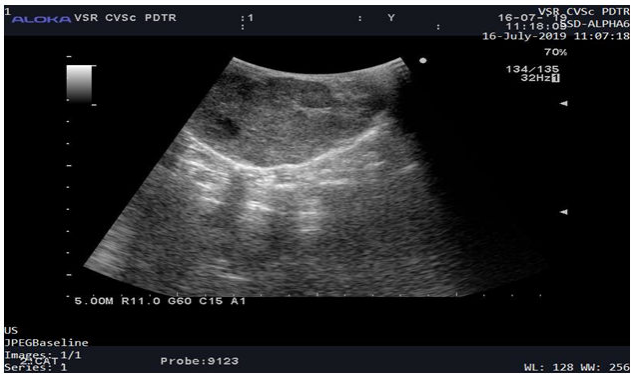
Figure 3. B-mode ultrasonographic image of canine mammary malignant tumor showing circumscribed irregular margins.

Hyperechogenic line

A hyperechogenic line (Figure 4) delimiting the neoplastic tissue from the healthy tissue was observed around the tumor in 26 cases (72.22%). Beneath the tumor mass, acoustic shadowing and acoustic enhancement (Figure 5) was observed.
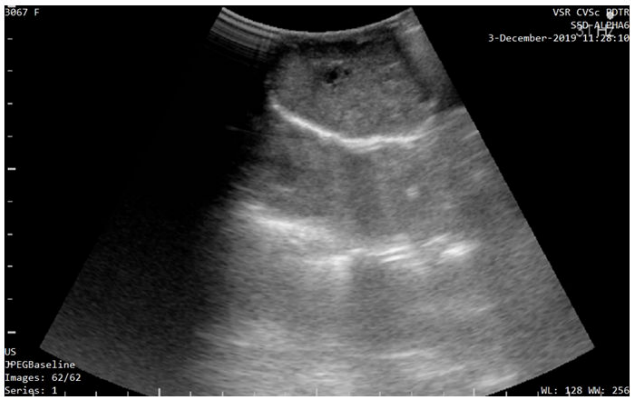

Figure 4. B-mode ultrasonographic image of canine mammary malignant tumor showing hyperechogenic line.
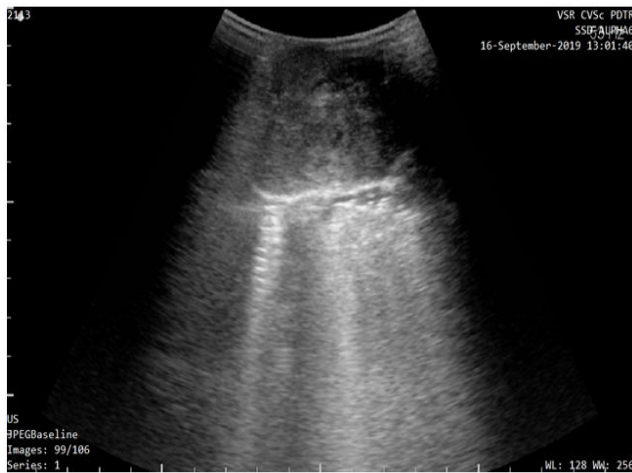
Figure 5. B-mode ultrasonographic image of canine mammary malignant tumor showing acoustic enhancement.

Echotexture

With respect to echotexture of tumor parenchyma, all tumors showed heterogenous parenchymal echotexture (Figure 6), in which ten cases showed cystic spaces (anechoic areas) in parenchyma (Figure 7) and remaining cases showed mixed echogenecity (Figure 8) throughout the parenchyma.

Figure 6. B-mode ultrasonographic image of canine mammary malignant tumor showing heterogenous parenchymal echotexture.

Figure 7. B-mode ultrasonographic image of canine mammary malignant tumor showing cystic spaces in parenchyma.

Figure 8. B-mode ultrasonographic image of canine mammary malignant tumor showing mixed echogenecity in parenchyma.

Discussion

Ultrasonography is a useful, non-invasive technique for directly imaging the internal and external anatomy of organs and tissues in two dimensions, in which a tissue's appearance on a grey scale varies with its characteristics [2] however, the technique is not used routinely to evaluate the mammary gland, whereas in human medicine ultrasonographic examination has been used as an adjunct to mammography since the early 1980's [3]. In the present study, B-mode ultrasonography was used to study the characteristics of canine mammary tumors. Among the 36 malignant tumors scanned, 26 cases (72.22%) showed indistinct margins whereas in remaining ten cases (27.78%), the margins were circumscribed. Mohammed et al. reported that the presence of uncircumscribed margins suggested an invasive growth and could also be interpreted as a sign of malignancy; however, the tumors in the present study showed both circumscribed and indistinct margins. Therefore, presence of circumscribed margins does not rule out malignancy. These findings are in agreement with Soler et al. who reported that margins of benign tumors were distinct in most cases as well as in most of malignant tumors, finding no significant differences between both groups. Another finding which was observed during the present study was presence of hyperechogenic line delimiting the neoplastic tissue from the healthy tissue. Presence of a capsule delimiting the neoplastic tissue from adjacent healthy tissue had a similar presentation in both benign and malignant tumors [4]. Therefore, hyperechogenic line cannot be used as an indicator of malignancy. Both acoustic shadowing and enhancement was observed in the present study. Certain tissue compositions might result in enhancement or shadowing as the ultrasonic beams propagate through tissues. Shadowing distal to a structure might result from attenuation, beam spreading due to refraction or reflection related to that structure. Central posterior shadowing is a common feature suggesting malignancy and is much more frequently present in low-grade malignancy [5]. The cause of posterior shadowing is the heterogeneous character of tumors [6]. The presence and arrangement of fibrous connective tissue has also been suggested to result in acoustic shadowing [7]. Nyman et al. reported appearance of acoustic shadowing in both benign and malignant

tumors that contained bone or mineralization. Acoustic enhancement refers to the increased echoes deep to structures that transmit sound exceptionally well. Posterior acoustic enhancement is most commonly discussed in the context of cystic lesions [8]. Although it was reported earlier that acoustic enhancement is a typical sign of benign tumors, malignant tumors in the present study showed acoustic enhancement. Therefore, acoustic enhancement and shadowing cannot be used to differentiate benign from malignant tumors. With respect to echotexture of tumor parenchyma, all tumors showed heterogenous parenchymal echotexture, in which ten cases showed cystic spaces (anechoic areas) in parenchyma and remaining cases showed mixed echogenecity throughout parenchyma. The heterogeneous echotexture of a tumor, especially if large, might be due to the presence of necrosis, cysts, oedema, haemorrhage, fibrous tissue, cartilage and bone among other [9]. Homogeneous echotexture was observed in benign tumors and higher frequency of heterogeneity was seen in malignant tumors in a report given by Soler et al. The tumors included under the present study were malignant in nature and had heterogenous parenchymal echotexture [10,11]. But Nyman et al. found a higher proportion of benign tumors showing heterogeneous echotexture. Contrarily, Feliciano et al. described a similar proportion of benign and malignant tumors having homogeneous echotexture. Hence it was assumed that, echotexture of tumor parenchyma does not play a significant role in detecting malignancy. Therefore, except for acoustic shadowing among the B-mode ultrasonographic parameters evaluated, other parameters do not play significant role in detecting malignancy [12,13].

Conclusion

Ultrasonographic studies can predict the malignancy but cannot be used as a definitive diagnostic method for confirming the malignant tumours.

References

1. Feliciano MAR, MC Maronezi, L Pavan and TL Castanheira, et al. "ARFI Elastography as a Complementary Diagnostic Method for Mammary Neoplasia in Female Dogs–Preliminary Results." *J Small Anim Pract* 55 (2014): 504-508.

2. Feliciano MAR, WRR Vicente and MAM Silva. "Conventional and Doppler Ultrasound for the Differentiation of Benign and Malignant Canine Mammary Tumours." *J Small Anim Pract* 53 (2012): 332-337.

3. Gozzi G, C Cressa, M Bazzocchi and Giorgio Stanta, et al. "Causes of attenuation of the Sound Waves in Neoplasms of the Breast. Histologic and Echographic Correlation Study." *Radiol Med* 72 (1986): 195-198.

4. Griffin PG and OJ Ginther. "Research Applications of Ultrasonic Imaging in Reproductive Biology." *J Anim Sci* 70 (1992): 953-972.

5. Kobayashi, Toshiji. "Diagnostic Ultrasound in Breast Cancer: Analysis of Retrotumorous Echo Patterns Correlated with Sonic Attenuation by Cancerous Connective Tissue." *J Clin Ultrasound* 7 (1979): 471-479.

6. Kossoff, G. "Causes of Shadowing in Breast Sonography." *Ultrasound Med Biol* 14 (1988): 211-215.

7. Maturen, Katherine E, Ashish P Wasnik, Janet E Bailey and Ellen G. Higgins, et al. "Posterior Acoustic Enhancement in Hepatocellular Carcinoma." *J Ultrasound Med* 30 (2011): 495-499.

8. Mohammed, Sulma Ibrahim, Giovanni Battista Meloni, ML Pinna Parpaglia and Vincenzo Marras, et a. "Mammography and Ultrasound Imaging of Preinvasive and Invasive Canine Spontaneous Mammary Cancer and their Similarities to Human Breast Cancer." *Cancer Prev Res* 4 (2011): 1790-1798.

9. Nyman, Helena T, Ole L. Nielsen, Fintan J. McEvoy and Marcel H. Lee, et al. "Comparison of B-Mode and Doppler Ultrasonographic Findings with Histologic Features of Benign and Malignant Mammary Tumors in Dogs." *Am J Vet Res* 67 (2006): 985-991.

10. Ricci, Paolo, Elena Maggini, Ester Mancuso and Pietro Lodise, et al. "Clinical Application of Breast Elastography: State of the Art." *Eur J Radiol* 83 (2014): 429-437.

11. Säbel, Manfred and Horst Aichinger. "Recent Developments in Breast Imaging." *Phys Med Biol* 41 (1996): 315.

12. Soler, Marta, Elisabet Dominguez, Xiomara Lucas and Rosa Novellas, et al. "Comparison between Ultrasonographic Findings of Benign and Malignant Canine Mammary Gland Tumours Using B-Mode, Colour Doppler, Power Doppler and Spectral Doppler." *Res Vet Sci* 107 (2016): 141-146.

13. Zhou, JianQiao, Weiwei Zhan, YiJie Dong, ZhiFang Yang and Chun Zhou. "Stiffness of the Surrounding Tissue of Breast Lesions Evaluated by Ultrasound Elastography." *Eur Radiol* 24 (2014): 1659-1667.