

The Role of 3D Ultrasound and 3D Power Doppler Imaging in the Diagnosis and Evaluation of Ovarian Cancer: New Perspectives

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BACKGROUND

Ovarian cancer is in frequency the third cancer of female genital tract, after those of uterus and cervix. However, its mortality is greater, and this is basically due to the difficulty in its early diagnosis, because it does not usually show symptoms until advanced stages and risk factors to develop it are unknown.

A 3000 new cases of ovarian cancer are diagnosed a year, and practically 80% of women are diagnosed in advance stages (III or IV), with a resultant overall five-year survival rate of approximately 20%.¹

The current diagnostic orientation of ovarian cancer is essential, not only for the repercussion the moment of the diagnosis has in the survival rates, but for the necessity of a correct planning in clinical conduct, referring the patient to specialized centers, and the necessity of a correct planning of a ruled radical surgery of ovarian cancer (surgical times, surgeon, etc.).

Habitually, diagnosis of adnexal masses is carried out attending to imaging methods, fundamentally ultrasonography, and serum tumor markers.²⁻⁵

There are different scoring systems to evaluate adnexal masses ultrasonographically. Ultrasound signs of malignant ovarian tumors include multilocular or multiple cysts, thick or irregular septa or walls, poorly defined borders, papillary projections, solid components and echogenic elements (Table 1).

Solid echogenicity within the tumor is considered potentially malignant, although a high false-positive rate should be considered in the differential diagnosis of malignant masses. Conventional color and pulsed Doppler have been introduced to improve the diagnostic accuracy of gray-scale morphological ultrasonography, but the results are of limited value.⁶⁻¹²

In spite of technical advances, survival rates of ovarian cancer have not been improved, for what is necessary to continue investigating in new more sensitive and specific techniques to improve early diagnosis of ovarian tumors.

Three-dimensional ultrasound offers two advances over conventional ultrasound, improved spatial orientation in association with surface rendering and objective quantification of an organs volume and blood flow.¹³

Regarding ovarian tumors, potential advantages of 3D ultrasound would be a more accurate diagnosis of ovarian cancer and the possibility of its detection in early stages. 3D power Doppler angiography (3D-PDA) allows the acquisition of power-Doppler data from an organ or area of tissue as a whole, which may then be displayed providing a means to assess spatial parameters of tissue vascularity (such as a cluster or branching patterns of a vascular network). Through the histogram facility we can investigate tumor neovascularity, calculate vascularization, parameters and assess tumors blood flow in different stages of growth. There are three indices of vascularity to quantificate an organs blood supply applying

Table 1: Ultrasonographic morphologic scoring system by Bajo JM *et al* (2002)

Scores	0	1	2
Limits	Defined	Partly poorly defined	Poorly defined
Borders	Regular	Partly irregular	Mostly irregular
Echogenicity	Sonolucent	High echogenicity	Mixed echogenicity
Inner walls structure	Smooth and < 3 mm	Irregular and/or >3 mm	Papillarities
Septa	No	< 3 mm	> 3 mm



Figs 1 and 2: Three-dimensional ultrasonography may allow a better evaluation of inner walls structure such as a papillaries

3D-PDA: Vascularization index, that reflects the ratio of power Doppler information within the total dataset relative to both color and gray-scale information, the flow index, that represents the mean power Doppler signal intensity, and the vascularization flow index, that is a combination of the two.¹⁴⁻¹⁶

NEW PERSPECTIVES

The potential advantages of 3D ultrasound over conventional ultrasonography have been examined in a number of studies to determine their diagnostic value in women with possible gynecological malignancies. These studies vary greatly in their design and patient populations, and offer extensive and possibly contradictory results.

In a pioneer work, Bonilla-Musoles *et al* tried to determine whether 3D ultrasound may offer advantages over 2D ultrasound as a screening tool for the evaluation of ovarian lesions. They evaluated 76 women with ovarian masses first detected with conventional ultrasound, basing the 3D sonographic criteria for malignancy in the morphologic scoring system for 2D ultrasound proposed by different authors. They stated that observation of papillary projections, characteristics of cystic walls, and the extent of capsular infiltration was superior with 3D ultrasound in comparison to conventional 2D sonography, as was the calculation of ovarian tumor volume. They also indicated that eventually 3D ultrasound imaging will allow diagnosis of ovarian malignancy at an earlier stage (Figs 1 and 2).¹⁷

Hata *et al*, in a study of 20 ovarian tumors, reported a higher specificity and accuracy, and a lower false-positive rate for 3D ultrasound compared with 2D sonography, suggesting that 3D ultrasonography might be a better means of differentiating

between malignant and benign ovarian tumors.¹⁸ Both works considered similar morphologic criteria for the diagnosis of ovarian malignancy. Other authors, however, point out that the most important variable in predicting malignancy is the presence or absence of solid elements within the tumor, and find that the use of 3D transvaginal sonography does not significantly improve the 2D transvaginal sonographic morphologic assessment of complex adnexal masses, though it is useful for reinforcing initial diagnostic impressions.¹⁹⁻²¹

Concerning power Doppler evaluation of complex adnexal masses, Cohen *et al* published a study over 71 women in which despite all malignancies were correctly identified by both 2D and 3D imaging, the specificity was significantly improved with the addition of 3D power Doppler.²²

In an analysis of 43 patients with suspected stage I ovarian cancer, Kurjak *et al* show that 3D power Doppler and especially the combined use of 3D sonography and power Doppler imaging significantly improve diagnosis accuracy in preoperative sonographic assessment of suspected ovarian lesions.^{23,24}

Fishman *et al* examining the usefulness of sonography in the detection of early-stage of epithelial ovarian cancer find that specificity significantly improved by the addition of 3D Doppler imaging as a secondary test to determine the location of blood flow, but Guerriero *et al* argued that there is little evidence that 3D Doppler imaging is significantly better than results with 2D gray-scale and color Doppler imaging. Likewise, Testa *et al* deem that the use of 3D quantification of tumor vascularity yields a diagnostic accuracy, that is, similar to that of subjective evaluation of vascularity.²⁵⁻²⁷

Alcazar *et al*, however, find that the 3D-PDA index seems to improve the accuracy in evaluation of complex vascular masses compared with conventional power Doppler index.²⁸

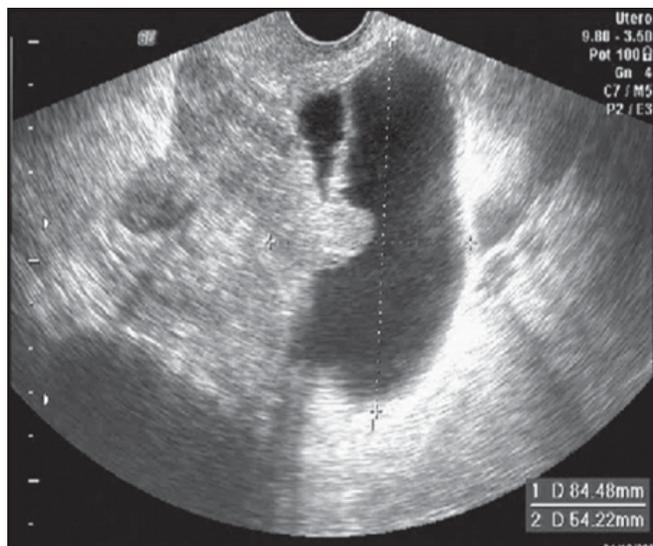


Fig. 3: Complex ovarian tumor. B-mode showed noticeable solid component protruding into the cystic cavity of the tumor. Note thick septa on the basis of the lesion

CONCLUSIONS

Three-dimensional sonography examination contributes to carry out a volumetric reconstruction of the examined objects and allows an objective quantification of blood flow.

Some studies suggest that it might be a better means in the evaluation of complex adnexal masses. Therefore, further studies are necessary to demonstrate the improved sensitivity and specificity compared to conventional 2D ultrasound (Fig. 3).

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