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Color Doppler study for differentiation of various adnexal masses

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ABSTRACT

Aim: To evaluate the color Doppler studies to differentiate between the benign and malignant adnexal masses.

Material & Methods: One Hundred and sixty five women with adnexal masses underwent Doppler Color sonography and Pulsality index, Peak systolic velocity, distribution of vascularity and dicrotic notch was examined and assessed for their significance.

Results: Of the 138 benign cases, color Doppler study could diagnose 136 cases as benign but labeled two cases as malignant which were actually benign. Out of 27 malignant cases, all 27 cases were diagnosed as malignant by color Doppler study. Our study showed sensitivity 100%, specificity 93.1%, positive predictive value 98.5% and negative predictive value 100% of color Doppler.

Conslusions: Color Doppler study is helpful in differentiating benign from malignant adnexal masses.

Key Words: Cancer, Malignancy, Benign, Ovary, Ultrasonography, Color, Adnexa, Systolic, Frequency

INTRODUCTION

Adnexal mass is a common presentation in office visit to a general gynaecologist. Adnexa consist of fallopian tubes, ovaries, broad ligament, and structures within broad ligament that are developed from the embryonic nests. Differential diagnosis of adnexal mass is complex. Adnexal mass may be of gynaecological or non-gynaecological origin. Differential diagnosis of abnormal mass includes functional cysts, neoplastic cysts, tubo-ovarian abscesses, hydro salpinx, ectopic pregnancies, malignant ovarian tumors, paraovarian cysts, tubal malignancy, broad ligament cyst, fimbrial cysts, sigmoid colon or colon distended with gases or faeces, pelvic kidney and pregnancy in bicornuate uerus etc.

An adnexal mass may be benign or malignant; it is the risk of malignancy that propels us for early, accurate and prompt diagnosis to lessen the mortality and morbidity. An adnexal mass often involves ovary, because of the propensity of the ovary for neoplasia, fewer neoplasms occur in the fallopian tube, it is commonly involved in inflammatory process. With the development of sonography including Doppler study we are able to make early and more specific pre- and intra-operative evaluation of adnexal mass and to develop individual strategies of adnexal mass to avoid unnecessary interventions.

Color Doppler study increases the diagnostic accuracy of plain sonography. The measurement of vascular resistance with Doppler is an important complement

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to Trans abdominal sonography (TAS) Transvaginal sonography (TVS). Most malignant tumors share the phenomenon of neovascularization as the blood flow is considerably increased. Doppler study is expensive, technically difficult as compared to plain conventional gray scale sonography but it can be done at the same time during sonographic evaluation. Even after using sonography and colour evaluation, histopathology is taken as gold standard for evaluation of benign and malignant adnexal masses. Our study has been aimed at various Doppler parameters to make a diagnosis of malignant lesions. In order to compare the diagnostic accuracy, conventional gray scale ultrasonography was performed with morphologic characterization of internal architecture followed by color Doppler imaging.

PATIENTS AND METHODS

TAS and TVS real time gray scale ultrasonography was followed by color Doppler sonography in patients. The machine used was LOGIQ 500 color Doppler unit from GE Medical system the probes used were 3.5MHz for TAS and 7.5MHz for TVS.

After laparotomy/laparoscopy, the gross and cross sectional findings of all speciments were correlated with USG findings and all specimens were sent for biopsy. The histopathological diagnosis was considered final and gold standard in all cases.

Color Doppler study was performed in 165 cases. Pulsality index (PI), vessel localization, peak systolic velocity and presence and absence of dicrotic notch were noted down in each patient. No flow was seen in 32 cases out of 138 benign cases so all color Doppler criteria could not be studied in them. So all the Doppler criteria could be applied to only 133 cases.

RESULTS

Fifty-one benign cases out 106 cases (48.11%) had PI>1.5 but none of the malignant mass had PI>1.5. Twenty two cases out 27 (81.48%) malignant cases had PI< 1 but only 20 benign cases out of 106 (18.86%) had PI<1. (Table 1) 71.69% and 23.58% of benign cases has peripheral and septal distribution of vessel and only 4.71% had central vessel localization but 59.25% of malignant masses had central distribution and only 25.92% and 14.8% had peripheral and septal vessels. (Table 2) 68.86% of benign and 51.85% of malignant masses had Peak systolic velocity (PSV)>20cm/sec. Only 31.13% of benign masses as compared to 48.148% of malignant masses had PSV 10–20 cm/sec. (Table 3) All the patients with malignant masses had absent dicrotic notch. In 84.91% of benign cases, dicrotic notch was present and in 15.09% cases, it was absent. (Table 4)

Out of total 138 benign cases, color Doppler study could diagnose 136 cases as benign but labeled two cases as malignant, which were actually benign. Out of 27 malignant cases, all 27 cases were diagnosed as malignant by color Doppler study. Our study showed a sensitivity of 100%, specificity 93.1% positive predictive value 98.5% and negative predictive value of 100% for color Doppler.

TABLE 1
Pulsality Index

Pulsality Index	Benign (106)	Malignant (27)	P value
PI > 1.5	51(48.11%)	0	<0.001
PI 1.5–1	35(33.01%)	5(18.52%)	Not significant
PI < 1	20(18.86%)	22(81.84%)	<0.001

TABLE 2
Vessel localization

Vessel localization	Benign (106)	Malignant (27)	P value
Peripheral	76(71.69%)	7(25.92%)	<0.001
Central	5(4.71%)	16(59.25%)	<0.001
Septal	25(23.58%)	4/(14.8%)	Not significant

TABLE 3
Peak systolic velocity

Peak systolic velocity	Benign (106)	Malignant (27)	P value
>20 cm/sec	73(68.86%)	14(51.85%)	Not significant
<10 cm/sec	0	0	Not significant
10–20 cm/sec	33(31.13%)	13(48.14%)	Not significant

TABLE 4
Dicrotic Notch

Dicrotic Notch	Benign (106)	Malignant (27)	P value
Present	90(84.91%)	0	
Absent	16(15.09%)	27(100%)	<0.001

DISCUSSION

Ovarian carcinoma is a leading cause of death from gynaecologic malignancy. The prognosis is related to the stage of the disease at the time of diagnosis. The 5 year survival is less than 5% for stage 4 disease and more than 80% for stage 1 disease[1–3]. Ultrasonography is the imaging modality of choice for the initial evaluation of women with suspected adnexal masses[4]. Certain sonographic features are required for the diagnosis of such malignancies. These include the ability to identify the ovary, a lesion within the ovary, thickening of the wall of a cystic lesion, thickened septa, solid portions, echogenecity of cystic content, calcification, neovascularity, local or vascular invasion and ascites[5–7]. It is generally accepted that the higher the frequency of the transducer and the closer the transducer is to the lesion, the better the delineation of detail and perhaps the detection of any abnormality. Information on the benign or malignant nature of these lesions are important as they have direct bearing on the clinical management including surgical planning.

The introduction of color Doppler ultrasonography has allowed the evaluation of tumor vascularity[8]. Several studies have assessed the value of this technique in the differentiation of benign from malignant adnexal masses with controversial results[9–11]. However its specific role in sonographically suspicious masses has not been extensively evaluated.

Doppler flow study of diagnosing adnexal masses evolved in 1990s. The close ultrasound similarity of benign and malignant tumor with solid components explains the limited ability of ultrasound to distinguish these lesions. Malignant tumors are rich in neovascularization, these vessels are often bizarre and rich in arterio venous anastomosis, hence there is diminished resistance to blood flow across these vessels[12]. Various reports describe the use of Doppler to detect the characteristically high flow in blood vessels of a malignant tumor[13–17]. Various criteria are taken into account in Doppler parameters. Major criteria are the relative impedance of the arterial signals, location of main or abnormal vascularity and the minor criteria are the maximum systolic velocity and the presence of dicrotic notch during the diastolic portion of waveform. Fleischer et al[18] said that vascular supply should be determined for each mass. Since the angle of the vessel and its diameter can only be approximated, the accuracy of the velocity estimation is between 5 to 10% when Doppler angle is between 20 and 60 degrees. Velocity is considered to be of less predictive value than the other parameters.

When no colour flow was displayed and no intratumoral signal could be obtained from the tumor or its wall, blood flow signals were collected from ovarian artery and adnexal branch of the uterine artery on the side of the tumor. PI of 1.0, Resistance index (RI) of 0.56 and Peak systolic velocity (PSV) of 15 cm/sec were considered as cut off level for benign tissues based on data from previous studies[13,14,19].

Our study revealed many important color Doppler findings to differentiate benign and malignant masses. Four major and minor parameters were studied in color Doppler sonography. Out of 165 cases in which color Doppler was performed, 138 (83.63%) were benign and 27 (16.36%) were malignant. Out of 138 (83.63%) benign masses, 32 (23.18%) cases showed total absence of flow so PI, vessel localization

and other parameters were not taken into consideration in these cases.

81.48% and 18.52% of malignant masses had pulsality index less than one and between 1.5–1 respectively but none had >1.5. Most of the benign tumors had PI more than 1.5 (48.11%) and only 18.86% had PI less than 1. PI forms an important major criterion in color Doppler study. Fleischer et al[18] 1980 also found out that benign masses have high PI malignant masses have low PI. Weiner et al[16] found that PI less than 1 was found to be characteristic of malignant ovarian lesions. At our institution, PI is a preferred criterion since it is more representative of all the frequencies within the waveform, particularly when there are frequencies below the base line or reversed flow. PI is calculated by computer program within the system by first setting the user on the leading edge of the systolic rise and tracing it over the entire waveform to the end diastolic velocity.

Our study showed predominantly peripheral and septal localization of vessels in benign masses (71.69% and 23.58%) and predominantly central vessel localization (59.25%) was observed in malignant masses. 32 benign tumors out of 138, showed absence of flow (23.15%) and on the other hand all the 27 malignant cases showed vascularity (100%) suggesting a more variegated consistency of tumor and presence of papillae, septations and vegetations with arrangement of vessels being more central.

In our study, 32 of 138 benign cases showed no flow, 68.86% had PSV > 20 cm/sec, and 31.13% between 10–20 cm/sec and none <20 cm/sec. All the malignant masses showed flow with PSV > 20 cm/sec in 51.85% and PSV between 10–20 cm/sec in 48.14%. Here the results of our study is not complying with the results of study by Fleischer et al[18] found in their study that malignant masses have higher PSV as compared to benign masses.

Dicrotic notch was seen in 84.9% of benign masses but none of malignant masses showed presence of dicrotic notch in our study. Study by Fleischer et al[18] has also concluded that waveform in most malignancy lack a dicrotic notch in the diastolic phase, which is an indicator of lack of muscular media.

Out of 138 benign cases, color Doppler study could diagnose 136 cases as benign but labeled two cases as malignant that were actually benign. Out of 27 malignant cases, all 27 cases were diagnosed as malignant by color Doppler study. Our study showed sensitivity 100%, specificity 93.1% positive predictive value 98.5% and negative predictive value 100%. Timor-Tritsch et al[20] found that sensitivity, specificity and positive predictive value of color Doppler in diagnosing benign and malignant adnexal masses was 94%,99% and 94% respectively. Study by Fleischer et al[18] showed sensitivity 85%, specificity 93% positive predictive value 85% and negative predictive value 98%.

In the color Doppler study we found low PI less than 1, an important feature of malignancy (81.48%) but PI less than 1 was also found in (18.86%) cases of benign masses so PI alone cannot be a feature to detect malignancy. Central vessel localization was found predominantly in malignancy (59.25%) while septal (23.58%) and peripheral (71.69%) vessel localization was seen in benign masses. The vessel localization along with PI will further confirm malignancy.

Though high PSV is said to be a feature of malignancy but our study could not prove any correlation between velocity and malignancy. This can be explained because accurate velocity estimation is difficult as the angle of the vessel and its diameter can only be approximated. Absence of dicrotic notch was found to be an important feature of malignancy.

Newer ways of analyzing the information contained in Doppler signals might prove rewarding. Possibly the amount of colour signal detectable in a tumor i.e. the objective quantification of color Doppler signals obtained with the new color Doppler modality, color Doppler energy, configuration of vessel tree and estimation of total tumor perfusion may further prove useful in the detection of malignant cases.

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