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CLINICAL ARTICLE

Three-dimensional power Doppler in the evaluation of painful leiomyomas and focal uterine thickening in pregnancy

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Leiomyoma;
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Abstract

Objective: To determine the usefulness of 3-dimensional (3D) power Doppler ultrasound in distinguishing painful leiomyomas from focal myometrial contractions or nonpainful leiomyomas in pregnancy. *Methods:* A 2D section of the area of interest in the uterine wall was first obtained in 29 patients to determine whether the pain originated from a myoma or a uterine contraction. Then, volume acquisition was activated and Doppler indices (vascularization index, flow index, and vascularization–flow index) were calculated for thickened and normal uterine wall. *Results:* Of 15 patients found to have uterine myomas, 11 had multiple tumors and 4 had single tumors. In the remaining 14 patients the painful uterine thickening proved to be a focal contraction. Painful segments of uterine thickening were associated with lower Doppler indices. Painful myomas were found to have significantly lower indices than normal uterine wall (P=0.008, 0.03, and 0.01 for VI, FI, and VFI, respectively, *vs.* 0.001, 0.003, and 0.01). However, the differences in indices between nonpainful myomas and uterine wall on the one hand, and nonpainful myomas and focal uterine contractions on the other, were not statistically significant. *Conclusion:* Three-dimensional power Doppler ultrasound may be a sensitive and reliable tool for distinguishing painful uterine myomas from focal myometrial contractions and nonpainful myomas.

1. Introduction

Focal abdominal pain is a frequent complaint during pregnancy. Round ligament pain, or pain caused by Braxton–Hicks contractions or degenerative changes in leiomyomas, should be distinguished from pain from serious causes such as placental abruption, pre-eclampsia, or preterm

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labor. Clinical presentation and physical examination do not always reveal the cause of focal abdominal or pelvic pain in pregnancy because the pain may be mild, its location may be atypical for the pathologic entity, and, in the case of an infection, fever and leukocytosis may be absent.

Uterine myomas, the most common of all neoplasms, are smooth-muscle tumors with a rate of growth related to estrogen and progesterone receptor levels [1]. Red degeneration (necrobiosis) is a form of degeneration that occurs characteristically but not exclusively in pregnancy, and the process is often the cause of pain and fever [2].

Typical features of red degeneration have been reported to occur in 10% of uterine myomas in pregnant women [3], but pain from red degeneration is often not easily distinguished from other causes of pain. Tumor vascularization can be examined and quantified *in vivo* by Doppler ultrasound, and several independent studies have determined imaging to be more sensitive with a power Doppler than with a color Doppler for the depiction of tumor vascularization and flow [4,5]. With the advent of three-dimensional power Doppler ultrasound, assessing volume and quantifying the power Doppler signal in the entire target organ has become possible [6]. The power Doppler has been used for the semiquantitative assessment of vessel density and perfusion within uterine tissue [7]. Rather than analyzing the frequency shift of Doppler signals, as does conventional color Doppler ultrasound, power Doppler analyzes their amplitude, a method that was found to be 3 to 5 times more sensitive in the visualization of small vessels and slower flows [8]. Because power Doppler is not affected by angle of insonation, it provides a better edge definition of vessels. All these features make the power Doppler mode ideal for 3D visualization of vasculature [9]. Color and volume histograms using virtual organ computer-aided analysis (VOCAL) and shell imaging were found to be reliable for the quantitative evaluation of vascularization [10].

In this study we used 3D power Doppler ultrasound to assess intramural and intratumoral vasculature in pregnant women with abdominal pain and focal uterine wall tenderness. It is hoped that our findings will be of assistance in the differential diagnosis of such cases.

2. Materials and methods

Twenty nine pregnant women complaining of abdominal pain in the second and third trimesters of pregnancy and found to have focal uterine tenderness were included in the study. Exclusion criteria included medical or pregnancy-associated complications and the presence of diffuse abdominal pain and tenderness.

The area of interest in the myometrium was then defined by a moveable sector on the screen. The sector having a shape of a truncated cone was adjusted in each case to minimize acquisition time. Identical power Doppler settings (color gain, −5.4; pulse repetition frequency, 0.9 kHz; WMF, low 2; quality, normal; balance, 150) were used in all patients. The 3D volume mode was then switched on, with volume acquisition time set on fast (low resolution) to avoid artifacts. The patient was instructed to hold her breath and remain very still and probe movements were avoided. Volume sampling took approximately 4 to 6 s, during which the area of interest was scanned in a fan-shaped pattern. Three orthogonal planes were simultaneously displayed on the screen, their perpendicular orientation maintained throughout any translation or rotation, and data were stored digitally on an internal disk drive for subsequent analysis. All examinations and further calculations were done by a single investigator (S.D.). The volume was rotated into a predefined view with plane A (upper left) showing the longitudinal view, plane B (upper right) displaying the transverse view, and plane C (lower left) demonstrating the frontal view. A minimum-intensity projection of the vascular images (lower right plane)

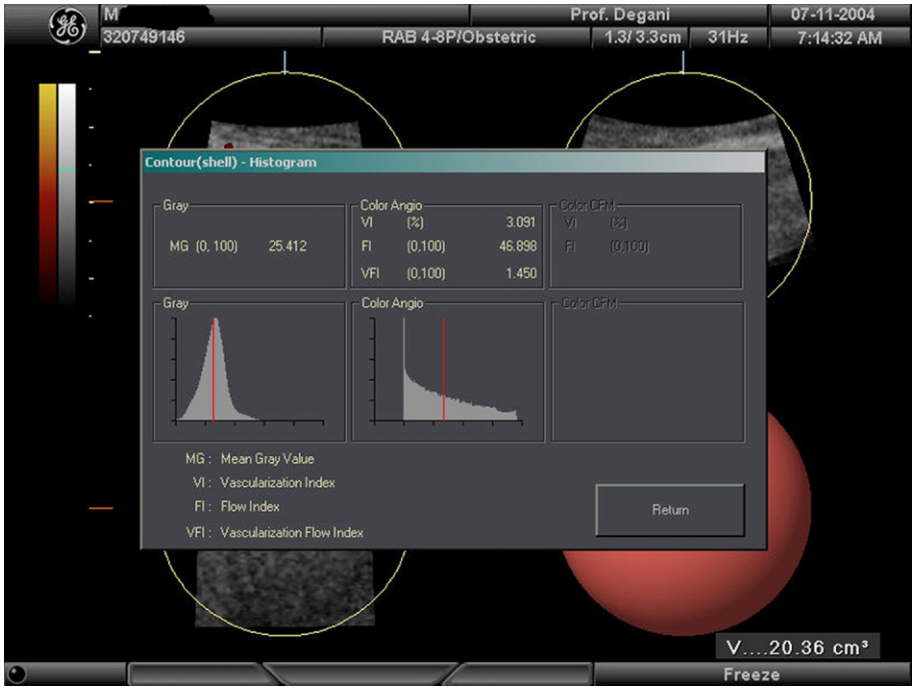

Figure 1 Histogram analysis of 3D power Doppler ultrasound of a sampled volume in a uterine myoma.