Contrast Enhanced Ultrasound in Assessment of Adnexal Masses

Essay
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List of abbreviations

AT	Arrival time
AUC	Area under curve
CDFI	Colour Doppler flow index
CE-TVS	Contrast enhanced transvaginal sonography
CEUS	Contrast enhanced ultrasound
CT	Computed tomography
DCE	Duration of contrast effect
Fig	Figure
IEE	lodipamide Ethyl Ester
MRI	Magnetic resonance imaging
MVD	Microvessel density
PFC	Perfluoro chemicals
PI	Peak intensity
RCNA	Radiological clinic of North America
ROI	Region of interest
TIC	Time intensity curve
TTP	Time to Peak
USCAs	Ultrasound contrast agents

List of figures

List Of Tables

Content

Introduction

Ultrasound examination is a relatively simple and cheap diagnostic method, and an experienced ultrasound examiner can often confidently and correctly distinguish between benign and malignant pelvic masses on the basis of subjective evaluation of gray scale and color Doppler ultrasound findings ***(Valentin, 2012)***.

Spectral Doppler sonography and color Doppler ultrasound have been used successfully in the evaluation of adnexal tumor vascularity ***(Fleischer et al., 2011).*** Although previous studies reported that both spectral Doppler and color Doppler ultrasound could provide clinically useful information related to adnexal tumor vascularity, these imaging modalities have inherent limitations, such as lack of sensitivity to slow flow, angle dependency, and aliasing, which occurs when the Doppler shift frequency exceeds one half the pulse repetition frequency ***(Bourne et al., 2007)***.

The recent introduction of US contrast agents has totally changed the depiction of specific vascular signs for a definite diagnosis by allowing a marked increase in signal from the vessels, especially with modern non-linear imaging techniques. Contrast-enhanced ultrasound (CEUS) allows an adequate depiction of vessels in relation to the pure intravascular

characteristics of those agents, reinforced by the real-time assessment of the enhancement after contrast injection. The recent availability of this imaging technique for transvaginal applications has allowed physicians to use CEUS in gynecology, such as in ovarian or uterine lesions, for a better assessment of vascular patterns that could play a role in diagnosis management ***(Marret et al., 2011)***.

Contrast specific imaging adds a high clinical value to ultrasound by allowing the differentiation between normal and pathologic tissue through the dynamic study of the micro- and macro-vasculature, the use of intravascular contrast agents can improve the detection of small vessels and low-volume blood flow ***(Gorce et al., 2010)***.

The use of a contrast agent improves the clarity of the power Doppler signal and aids identification of vascularized areas of a tumor; malignant lesions contain a significantly higher number of identifiable vessels than the benign lesions, before and after administration of the contrast agent. The differentiation of benign and malignant lesions can be increased by perfusional assessment of the lesion by using contrast agents to improve visualization of tumor vascularity and analysis of peak intensities and time/intensity curves ***(Sconfienza et al., 2010)***.

Aim of the work

To highlight the value & new application of contrast enhanced ultrasonography in evaluation of adnexal mass.

Anatomy

The female genital organs consist of internal and external group. The internal organs which are situated within the pelvis consist of the ovaries, the uterine tubes, the uterus and the vagina. ***(Wang et al, 2010)***

The vagina

The vagina is a functional organ of the female reproductive organ system. It extends from the vulva externally to the uterine cervix internally and is located within the pelvis, anterior to the rectum and posterior to the urinary bladder. ***(Xie et al. 2011)***

The vagina lies at a 90° angle in relation to the uterus and is held in place by endopelvic fascia and ligaments. It is a potential space that is easily distended. ***(Xie et al. 2011)***

Vasculature and lymphatic drainage

The vasculature of the vagina is supplied primarily by the vaginal artery, a branch of the anterior division of the internal iliac artery. Several of these arteries may be found on either side of the pelvis to richly supply the vagina. ***(Scully, 2010)***

Lymphatic drainage of the vagina is generally to the external iliac nodes (upper third of the vagina), the common and internal iliac nodes (middle third), and the superficial inguinal and perirectal nodes (lower third). ***(Scully, 2010)***

The uterus

The uterus is a pear-shaped organ located in the female pelvis between the urinary bladder anteriorly and the rectum posteriorly ***(figure 1).*** The average dimensions are approximately 8 cm long, 5 cm across, and 4 cm thick, with an average volume between 80 and 200 mL. The uterus is divided into 3 main parts: the fundus, body, and cervix. ***(Ozols et al. 2008)***

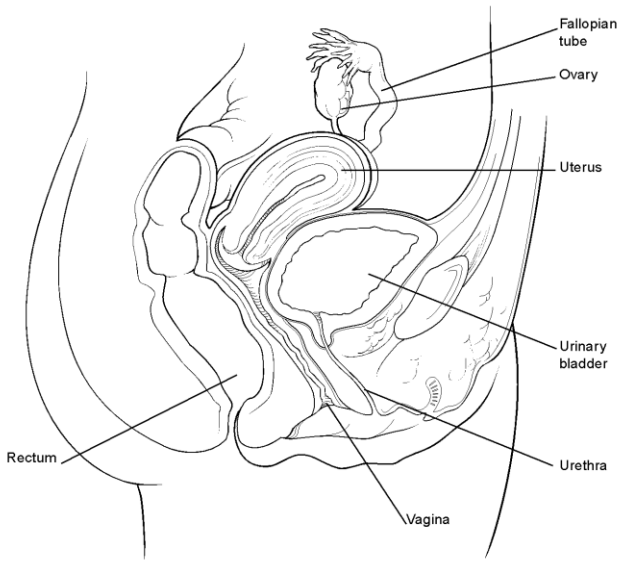

Figure (1): shape and position of the uterus (Patel et al. 2008)

The anatomy of the uterus consists of the following 3 tissue layers ***(fig 2)***:

- The inner layer, called **the endometrium**, is the most active layer and responds to cyclic ovarian hormone changes; the endometrium is highly specialized and is essential to menstrual and reproductive function
- The middle layer, or **myometrium**, makes up most of the uterine volume and is the muscular layer, composed primarily of smooth muscle cells
- The outer layer of the uterus, **the serosa or perimetrium**, is a thin layer of tissue made of epithelial cells that envelop the uterus. ***(Patel et al. 2008)***

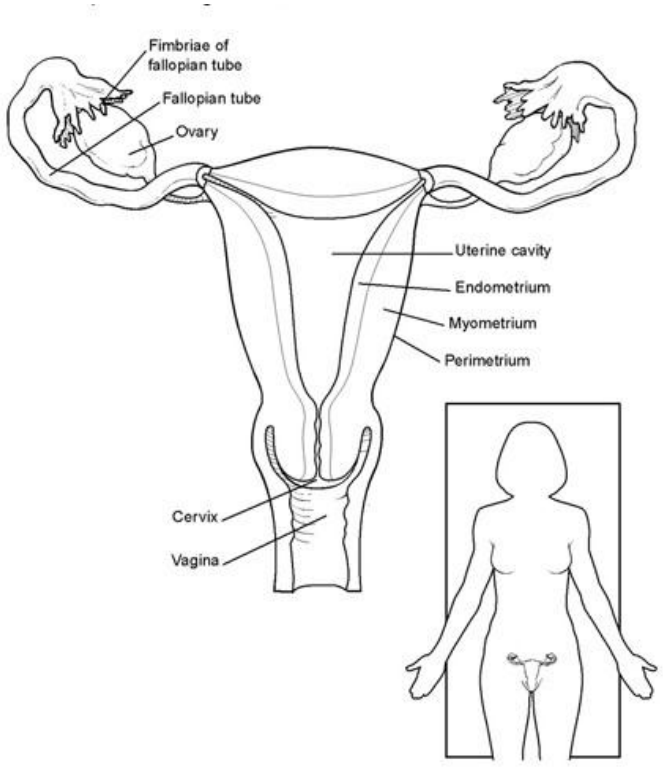

Figure (2): layers of the uterus (Ozols et al. 2008)

Blood is provided to the uterus by the ovarian and uterine arteries, the latter of which arise from the anterior divisions of the internal iliac artery. The uterine artery occasionally gives off the vaginal artery (although this is usually a separate branch of the internal iliac around), which supplies the upper vagina, and the arcuate arteries, which surround the uterus. It then further branches into the radial arteries, which penetrate the myometrium to provide blood to all layers, including the endometrium. ***(Demidov et al. 2011)***

Once these vessels reach the endometrial level, they branch into the basal arteries and spiral arteries, which support the specialized functions of each layer**.** The basal arteries are not responsive to hormones; they support the basal endometrial layer, which provides the proliferative cells for endometrial growth. The spiral arteries supply the functional layer and are uniquely sensitive to steroid hormones **(fig 3)**. In ovulatory cycles in which pregnancy does not occur**,** menses results following constriction of these terminal arteries, causing endometrial breakdown with desquamation of the glands and stroma. ***(Dolan et al. 2009)***

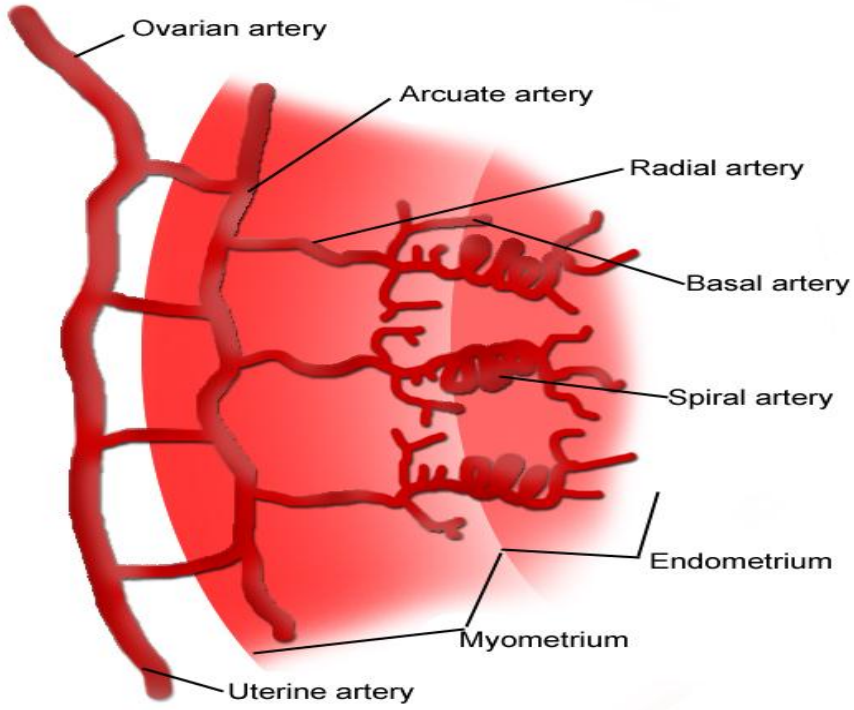

Figure (3): blood supply of the uterus (Dolan et al. 2009)

Ligaments support (figure 4):

The ligaments of the uterus are eight in number: one anterior; one posterior; two lateral or broad; two uterosacral; and two round ligaments. ***(Burns, 2009)***

The anterior ligament consists of the vesicouterine fold of peritoneum, which is reflected on to the bladder from the front of the uterus, at the junction of the cervix and body. ***(Burns, 2009)***

The posterior ligament consists of the rectovaginal fold of peritoneum, which is reflected from the back of the posterior