

CME Article

Pitfalls of gynaecological ultrasonography

C L Ong

ABSTRACT

Pitfalls in gynaecological ultrasonography may arise during acquisition of images, processing and interpretation. Physical interactions between the ultrasound and body structures may produce artifacts. Physiological processes such as functional ovarian cysts may mimic lesions. Different pathological processes may produce similar ultrasonographical appearances. To minimise errors in interpretation of gynaecological ultrasonography, one needs to be aware of the limitations of ultrasonography, and the similarities in the appearances of various physiological and pathological processes.

Keywords: gynaecological lesion, imaging anatomy, ovarian cysts, pelvic imaging, ultrasonography

Singapore Med J 2004 Vol 45(6):289-294

INTRODUCTION

Pitfalls are common in radiological diagnosis. They can arise during acquisition of images, processing, and interpretation. Acquisition of good ultrasonographical images depends very much on the operator. The right choice of ultrasound transducers, ultrasound frequency, and ultrasonographical skills are essential in minimising errors during acquisition. In gynaecological ultrasonography, most of the problems relating to acquisition of good images of the pelvic organs may be overcome with the use of transvaginal scanning. Ultrasound image processing depends on a number of physical factors of ultrasound itself and its interactions with body structures. The final step of interpretation requires the visualisation of the images and correlation with the clinical status of the patient. In gynaecological ultrasonography, a number of pitfalls in interpretation can occur. They may arise from the limitations of ultrasonography as an imaging technique, physiological processes that mimic pathology, and the similarity of ultrasonographical features of different pathological processes. Familiarity with gynaecological treatment and the changes that occur with such treatment are also essential for interpretation. The ultrasonologist needs to be conversant with ultrasound physics, pelvic anatomy, gynaecological physiology, gynaecological



Fig. 1 Ultrasound artifact. Coronal transvaginal US image of the uterus shows acoustic enhancement behind the endometrium that may be mistaken for a mass (arrows).

pathology, changes that result from medical intervention, and other pathologies that can occur in the pelvis, such as those in the urinary tract.

PITFALLS FROM PHYSICAL INTERACTION OF ULTRASOUND AND BODY STRUCTURES

During acquisition of ultrasonographical images, physical interactions between the ultrasound and structures in the body occur. Some of these interactions can and do result in artifacts. Such artifacts, if unrecognised, can result in misinterpretation. An example is the acoustic enhancement of ultrasound distal to the endometrium, especially during the secretory phase of the menstrual cycle⁽¹⁾. This may result in misinterpretation of the echogenic area behind the endometrium (Fig. 1) as a mass. The acoustic enhancement may also extend beyond the limits of the endometrium and be erroneously measured as the endometrium (Fig. 2). A heavily-calcified large fibroid may be partially-visualised on transvaginal ultrasonography due to strong acoustic shadowing and its size may be underestimated

Department of
Diagnostic Imaging
KK Women's and
Children's Hospital
100 Bukit
Timah Road
Singapore 229899

C L Ong, MBBS,
FRCR, FAMS
Senior Consultant

Correspondence to:
Dr Ong Chiou Li
Tel: (65) 6394 2283
Fax: (65) 6394 2258
Email: ocl@khh.com.sg



Fig. 2 Ultrasound artifact. Sagittal transvaginal US image shows extension of the acoustic enhancement (arrow) from the fundal end of the endometrium. This may result in erroneous measurement of the endometrial thickness.

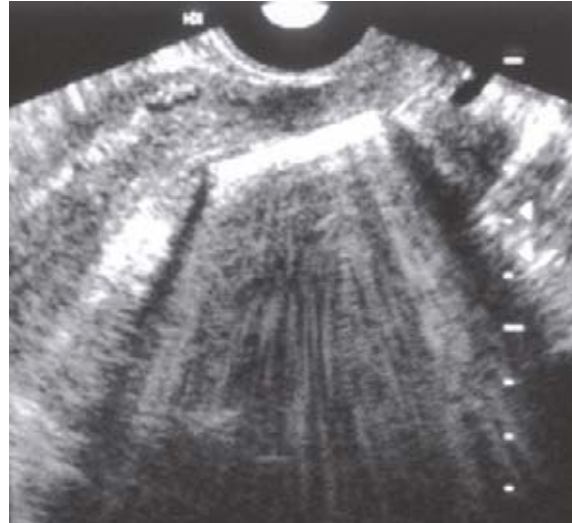


Fig. 4 Ultrasound artifact. Transvaginal US image of the uterus shows an intrauterine contraceptive device that casts a strong acoustic shadow, obscuring the distal parts of the uterus.



Fig. 3a Ultrasound artifact. Transvaginal US image of the uterus shows a heavily-calcified fibroid (arrows) that is partially imaged due to the strong acoustic shadowing. This results in underestimation of its size.



Fig. 5 Physiological process that mimics pathology. Transvaginal US image of an unusually large functional ovarian cyst that subsequently resolved.



Fig. 3b Transabdominal US image of the same fibroid (within cursors) shown in Fig. 3a. Its size is better appreciated using this approach.

(Fig. 3a). A better estimation may be possible with the transabdominal approach (Fig. 3b). Similarly, an intrauterine contraceptive device may also obscure parts of the uterus due to its acoustic shadow (Fig. 4).

PHYSIOLOGICAL PROCESSES THAT MIMIC LESIONS

The functional ovarian cyst can present a number of pitfalls. The ultrasonologist should be aware of the

cyclical nature of functional ovarian cysts that are common in women of reproductive age. These cysts vary in size according to the stage of the menstrual cycle. Most follicles mature and release their oocytes when they reach a diameter of around 25mm. A number may grow up to 30mm in diameter before releasing the oocyte. There are a rare few (Fig. 5) that grow larger than expected and present with dilemmas in management as they could be mistaken for ovarian neoplasms.

Corpora lutea may haemorrhage and form complex cysts that may mimic ovarian neoplasms^(2,3). These cysts can have a wide range of appearances. They may appear cystic with internal stranding (Fig. 6a), giving rise to a “fishnet” appearance. Their physiological nature is confirmed when they resolve on follow-up (Fig. 6b). Haemorrhagic cysts may contain solid-looking areas due to blood clots or may appear entirely solid (Fig. 7). They are found during the luteal phase of the menstrual cycle, and are common in women of reproductive age. Follow-up scans are recommended during the early phase of the next one or two menstrual



Fig. 6a Physiological process that mimics pathology. Transvaginal US image of a complex ovarian cyst (arrows) with internal stranding.



Fig. 6b Transvaginal US image shows resolution of the cyst shown in Fig. 6a. Small follicles are now seen in the ovary.



Fig. 7 Transvaginal US image shows a solid-looking haemorrhagic cyst (arrowheads) that may be mistaken for an ovarian tumour. A rim of normal ovarian parenchyma is seen.



Fig. 8 Composite transabdominal US image of a large cystic teratoma (arrowheads) of almost homogeneous echogenicity that is located superior to the uterus. The echogenicity of this mass blends in with the surrounding bowels (E: embryo).



Fig. 9 Sagittal US image of a cystic teratoma shows mixed echogenicity with echogenic foci and fluid components. An abscess may give a similar appearance.

cycles to confirm their cyclical nature as they usually resolve. Their hypervascular walls on colour Doppler ultrasonography can help to distinguish them. They may also be sometimes mistaken for ectopic pregnancies due to their echogenic walls⁽²⁾. These cysts, however, cannot be easily differentiated from endometriomas at the time of the first scan. Both contain haemorrhagic contents that can look very similar. Endometriomas are usually persistent⁽⁴⁾ compared to the cyclical nature of haemorrhagic functional cysts.

LESIONS THAT MIMIC OTHER PATHOLOGICAL PROCESSES OR NORMAL STRUCTURES

A common benign neoplasm of the ovary, the mature cystic teratoma, presents with a wide variety of appearances⁽⁵⁾. It is recognised by its echogenic contents that consist of fatty material and calcifications or teeth. Due to its echogenicity, the lesion may merge with surrounding bowel⁽⁵⁾ and be missed during scanning (Fig. 8). They may also resemble abscesses⁽⁵⁾ (Fig. 9), but should be differentiated by their clinical presentation. The gas within some abscesses can produce reflective echoes that may be mistaken for calcifications.

Pedunculated leiomyomas may be mistaken for ovarian tumours when they extend into the adnexal region (Fig. 10). The likelihood of making a mistake is increased when the ipsilateral ovary cannot be identified. Leiomyomas may undergo cystic degeneration⁽⁶⁾ and resemble cystic ovarian tumours (Fig. 11). Demonstration of a pedicle or bridging vessels between the uterus and the fibroid⁽⁷⁾ can help to resolve the problem (Fig. 12). Magnetic resonance (MR) imaging may help to distinguish leiomyomas from other solid pelvic masses when ultrasonography is indeterminate⁽⁸⁾. A number of conditions may resemble the uterine fibroid. This includes the fundus of the retroverted uterus, the second horn of a bicornuate uterus, solid ovarian masses (Fig. 13), and bowel masses (Fig. 14). Careful scanning with attention to ultrasonographical features helps to distinguish among such lesions.



Fig. 10 US image of a left adnexal solid mass (M) that turned out to be a uterine leiomyoma, lying adjacent to the ovary (O).



Fig. 13 US image shows a large solid ovarian tumour (M) located posterior to the uterus (U), mimicking a large fibroid.



Fig. 11 Pathological lesions that mimic each other. US image of a cystic left adnexal mass with a thick wall that was originally thought to be ovarian in origin, but turned out to be a degenerated fibroid.



Fig. 14 Condition that may be mistaken for uterine fibroid. Longitudinal US image shows the uterus (U) and a mass (M) located anterior to its fundus and superior to the urinary bladder. The mass was a colonic carcinoma.



Fig. 12 Colour Doppler US image shows the uterus (U) with a pedunculated fibroid (M). Bridging vessels between the two structures that are demonstrated helps to establish the origin of the mass.



Fig. 15 Longitudinal US image shows a markedly-distended vagina (V) due to haematocolpos that resembles the urinary bladder.

Large cystic unilocular masses in the pelvis can result from a number of conditions. They include an over-distended urinary bladder, bladder diverticula, cystic ovarian tumours, or a grossly-distended vagina due to imperforate hymen (Fig. 15). A cystic ovarian tumour may masquerade as the urinary bladder (Fig. 16) and be missed. Excessive bowel gas due to massive bowel distension may obscure all structures and present as a large anechoic area that may be mistaken for a very large cyst (Fig. 17). A large solitary bladder diverticulum can also be mistaken for a cystic lesion⁽⁹⁾.

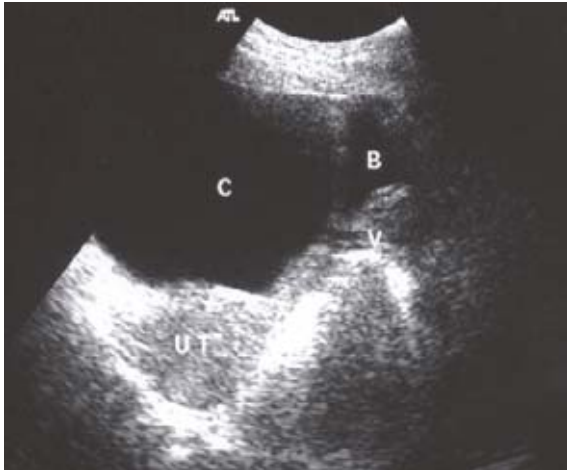


Fig. 16 Longitudinal US image shows an ovarian cyst (C) that could have been mistaken for the urinary bladder if not for the small amount of urine present (B) (UT: uterus, V: vagina).



Fig. 17 Longitudinal US image shows a generally echo-poor abdomen due to marked dilatation of the colon. The echo-poor area was mistaken for a mass (as labeled).

PITFALLS RELATED TO THE URINARY TRACT

Tubular structures in the pelvis may arise from various structures. They may be hydronephroses, hydrosalpinges or vascular structures. Distinction between a vascular structure from a non-vascular one may be made on Doppler ultrasonography. Hydronephroses may be confirmed by examining the kidneys for hydronephroses, and where possible, by tracing the ureters to the kidneys. Hydrosalpinges are usually harder to confirm, but may be diagnosed if found in the adnexal regions, in the absence of the other features described for vascular structures and hydronephroses. The pelvic kidney may sometimes be partially seen on transvaginal ultrasonography and be mistaken for a mass (Fig. 18a). Its true nature may be better assessed on careful transabdominal scanning (Fig. 18b).

CONCLUSION

To minimise errors in interpretation of ultrasonographical findings, one needs to be aware of the limitations of ultrasonography, and the similarities in the appearances of various physiological and pathological processes. Familiarity with the physiological changes that affect the uterus and ovaries is essential. Adequate clinical information



Fig. 18a Transvaginal US image shows a mass (within cursors) adjacent to the uterus (UT). The "mass" was actually a partially-imaged pelvic kidney.



Fig. 18b Transabdominal US image confirms that the "mass" shown in Fig. 18a to be a pelvic kidney (arrows).

can be vital and should be provided. Confirmation of findings with other imaging modality such as computed tomography or MR imaging may be required.

REFERENCES

- Forrest TS, Elyaderani MK, Muilenburg MI, Bewtra C, Kable WT, Sullivan P. Cyclic endometrial changes: US assessment with histologic correlation. *Radiology* 1988; 167:233-7.
- Jain KA J. Sonographic spectrum of hemorrhagic ovarian cysts. *J Ultrasound Med* 2002; 21:879-86.
- Baltarowich OH, Kurtz AB, Pasto ME, Rifkin MD, Needleman L, Goldberg BB. The spectrum of sonographic findings in haemorrhagic ovarian cysts. *Am J Roentgenol* 1987; 14:901-5.
- Patel MD, Feldstein VA, Chen DC, Lipson SD, Filly RA. Endometriomas: diagnostic performance of US. *Radiology* 1999; 210:739-45.
- Hertzberg BS, Kliewer MA. Sonography of benign cystic teratoma of the ovary: pitfalls in diagnosis. *Am J Roentgenol* 1996; 167:1127-33.
- Baltarowich OH, Kurtz AB, Pennell RG, Needleman L, Vilaro MM, Goldberg BB. Pitfalls in the sonographic diagnosis of uterine fibroids. *Am J Roentgenol* 1988; 151:725-8.
- Laing FC, Brown DL, DiSalvo DN. Gynecologic ultrasound. *Radiol Clin N Am* 2001; 39:523-40.
- Weinreb JC, Barkoff ND, Megibow A, Demopoulos R. The value of MR imaging in distinguishing leiomyomas from other solid pelvic masses when sonography is indeterminate. *Am J Roentgenol* 1990; 154:295-9.
- Karcnik TJ, Simmons MZ, Abujudeh H. Ultrasound of the adult urinary bladder. *Ultrasound Q* 1999; 15:135-47.

SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

Multiple Choice Questions (Code SMJ 200406B)

	True	False
Question 1. The following can result in diagnostic pitfalls during gynaecological ultrasonography:		
(a) Use of only the transvaginal approach in scanning the female pelvis.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Pathological processes with similar ultrasonographical features.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Acoustic shadowing from the endometrium during the secretory phase of the menstrual cycle.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Presence of an intrauterine contraceptive device.	<input type="checkbox"/>	<input type="checkbox"/>
Question 2. Functional ovarian cysts:		
(a) Show cyclical change.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Seldom enlarge greater than 2cm in diameter.	<input type="checkbox"/>	<input type="checkbox"/>
(c) May demonstrate complex features on ultrasonography.	<input type="checkbox"/>	<input type="checkbox"/>
(d) May be mistaken for ovarian neoplasms.	<input type="checkbox"/>	<input type="checkbox"/>
Question 3. The following ultrasonographical features may be seen in corpus luteal cysts:		
(a) Solid papillary structures along the internal wall.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Fine internal stranding due to haemorrhage.	<input type="checkbox"/>	<input type="checkbox"/>
(c) May resemble a pedunculated fibroid.	<input type="checkbox"/>	<input type="checkbox"/>
(d) May be mistaken for ectopic pregnancy.	<input type="checkbox"/>	<input type="checkbox"/>
Question 4. Similarities in ultrasonographical features may be seen in the following conditions:		
(a) Mature cystic teratomas may resemble bowel loops.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Haemorrhagic functional cysts may show features similar to endometriomas.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Fibroid and fundus of a retroverted uterus may be similar.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Endometriomas and ectopic pregnancies may be similar.	<input type="checkbox"/>	<input type="checkbox"/>
Question 5. The following statements are true:		
(a) An over-distended urinary bladder may be mistaken for an ovarian tumour.	<input type="checkbox"/>	<input type="checkbox"/>
(b) The pelvic kidney is better evaluated on transvaginal scanning.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Fibroids can be excluded from the differential diagnoses of a cystic adnexal mass.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Colour Doppler ultrasonography is essential for detection of blood flow in a tubular structure.	<input type="checkbox"/>	<input type="checkbox"/>

Doctor's particulars:

Name in full: _____

MCR number: _____ Specialty: _____

Email address: _____

Submission instructions:

A. Using this answer form

1. Photocopy this answer form.
2. Indicate your responses by marking the "True" or "False" box
3. Fill in your professional particulars.
4. Either post the answer form to the SMJ at 2 College Road, Singapore 169850 or fax to SMJ at (65) 6224 7827.

B. Electronic submission

1. Log on at the SMJ website: URL <http://www.sma.org.sg/cme/smj>
2. Either download the answer form and submit to smj.cme@sma.org.sg or download and print out the answer form for this article and follow steps A. 2-4 (above) or complete and submit the answer form online.

Deadline for submission: (June 2004 SMJ 3B CME programme): 25 July 2004

Results:

1. Answers will be published in the SMJ August 2004 issue.
2. Successful candidates will be notified by email in August 2004.
3. Passing mark is 60%. No mark will be deducted for incorrect answers.
4. The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council.