

Comprehensive Diagnostic Strategy for Cystic Masses in the Female Pelvis with Advanced MR Techniques

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**[Purpose]** Various benign and malignant tumors and tumor-like lesions in the female pelvis may appear as cystic masses. We describe the optimized MR protocol for evaluating cystic masses and the added value of advanced MR techniques: Diffusion-weighted imaging (DWI); Fat/Water separation techniques; Susceptibility-weighted imaging (SWI); High-resolution (HR) MRI at 3T; 3D-Dynamic contrast enhanced (DCE) MRI; MR Spectroscopy (MRS), in identifying the tumor origin, in distinguishing benign and malignant lesions, in determining specific histological subtypes, and for the planning of adequate treatment.

**[Outline of Content]** 5 steps to diagnose the cystic masses in the female pelvis by using conventional MRI and advanced MR techniques.

Step 1: Lesion localization (adnexal, uterine, or non-gynecologic origin?)

- Ovary detection** (ovarian or extra-ovarian origin) /**Lesion localization** (extra-peritoneal or intra-peritoneal, specific primary organ identification)
- Extra-peritoneal:** Presacral (Teratoma, Tail gut cyst, Anterior meningocele), Lateral (Lymphocele, Mega-ureter), Presacral/Lateral (Ancient schwannoma), Anterior prevesical space of Retzius (Urachal lesions), Pelvic floor (Urethral diverticulum, Subcutaneous cystic masses)
  - Peritoneal cavity:** Peritoneal (Lymphangioma, Cystic mesothelioma, Peritoneal inclusion cyst), Intestinal (Appendiceal mucocele, Duplication cyst),
  - Others:** Endometrial cysts (implants), Abscesses
  - Uterus:** Myometrial (Adenomyotic cyst, Adenomatoid tumor, Degenerated myoma, Leiomyosarcoma with massive necrosis), Cervical (LEGH, Nabothian cysts, Adenoma malignum), Enlarged cavity (Pyometra, Hydrometra, Hematometra)
  - Adnexal:** Extra-ovarian (Paraovarian cyst, Tubal dilatation: Hydrosalpinx, Pyosalpinx), Ovarian: (Functional cysts, Surface-epithelial inclusion cysts, Benign enlargement: Hyperreactio luteinalis, OHSS, Tubo-ovarian abscess, Endometrioma, Cystic tumors: benign & malignant)

Step 2: Evaluation of cystic components (Serous, Mucinous, Colloid, Fatty, Keratinous, Pus, or Hemorrhagic?)

Fluid characterization by using advanced MR techniques (Figs.)

Step 3: Morphologic appearances of the cyst (Monolocular, Multilocular, Multicystic, Tubular, or Irregular shaped?)

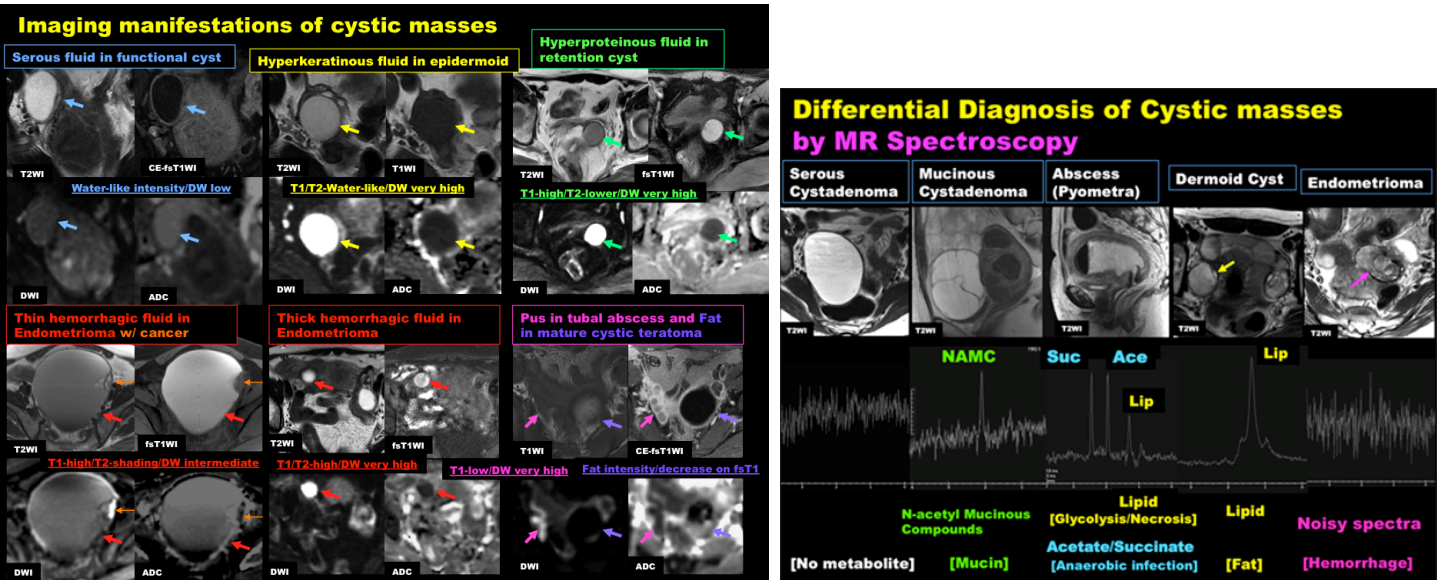
- Monolocular:** Non-neoplastic ovarian cystic masses, Various ovarian /extra-ovarian cystic tumors, **Multilocular:** Mucinous tumors (primary /secondary), **Multicystic:** Struma ovarii, Benign ovarian enlargement (Hyperreactio luteinalis, OHSS), Lymphangioma, Cystic mesothelioma, Uterine cervical cystic lesions (LEGH /Nabothian cysts), **Tubular:** Extra-ovarian: Fallopian tube/ Appendix /Ureter, **Irregular shaped:** Peritoneal inclusion cyst, **Multicentric:** Endometrioma (multiplicity), Lymphocele (solitary or multiple)

Step 4: Evaluation of cyst wall or septa: Mural nodules /thickened septa (DWI/3D-DCE MRI), Hemosiderin deposits (SWI), Free radical (T1WI), Calcification (CT), Granulation (CE/DWI), Fibrosis (T2WI/DWI)

Step 5: Clinical information: Age, Hormonal state, Pregnancy, Post-surgery, and Symptoms

Practical decision tree and tips for the differential diagnosis of cystic masses in the female pelvis are demonstrated.

**[Summary]** Systemic evaluation by using conventional MRI and advanced MR techniques may lead to the correct diagnosis of cystic masses in the female pelvis for the appropriate treatment to avoid excess surgical procedure.



Figs: Evaluation of cystic components: Serous, Mucinous, Colloid, Fatty, Keratinous, Pus, or Hemorrhagic?

Fluid characterization in the cystic masses by using conventional MRI and advanced MR techniques may attribute to the differential diagnosis. Decreased ADC due to hyperviscosity in pus, hyperproteinous or hyperkeratinous materials, T1/T2/DW-signal increase in subacute hemorrhagic contents, T2-signal decrease (shading) in thick hemorrhagic contents of endometriomas, and signal decrease on opposed phase image of chemical shift imaging in fat-scant mature cystic teratomas are useful imaging manifestations. MRS may provide metabolic information of cystic fluid contents such as N-acetyl mucinous compounds in mucinous materials, glycolysis/necrosis-associated lipid and anaerobic infection associated acetate /succinate in abscess, lipid from adipose tissue in mature cystic teratomas, and susceptibility induced noisy spectra in hemorrhagic contents.