

**Acute Pelvic Pain in the Reproductive Age Group  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. ACR-ACOG-AIUM-SRU Practice Parameter for the Performance of Pelvic Ultrasound. 2014; Available at: <a href="http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/US_Pelvic.pdf">http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/US_Pelvic.pdf</a> . Accessed September 30, 2015.	Review/Other-Dx	N/A	Practice parameter for the performance of pelvic US.	N/A	4
2. Moschos E, Twickler DM. Endometrial thickness predicts intrauterine pregnancy in patients with pregnancy of unknown location. <i>Ultrasound Obstet Gynecol.</i> 2008;32(7):929-934.	Observational-Dx	591 patients; complete data available for 517 patients	To determine whether endometrial thickness and other parameters are useful predictors of normal IUP in the setting of vaginal bleeding and sonographic diagnosis of pregnancy of unknown location.	4 variables (maternal age, estimated gestational age by last menstrual period, endometrial thickness and serum beta-hCG) were significant in the prediction of normal IUP (area under the ROC curve = 0.86). As maternal age, estimated gestational age by last menstrual period and beta-hCG increased, the likelihood of a normal IUP decreased, while as the endometrial thickness increased, the likelihood of a normal IUP increased. For each millimeter increase in endometrial thickness, the odds increased by 27% that the patient would have a normal IUP. No normal IUP had an endometrial thickness <8 mm.	3
3. Seeber B, Sammel M, Zhou L, Hummel A, Barnhart KT. Endometrial stripe thickness and pregnancy outcome in first-trimester pregnancies with bleeding, pain or both. <i>J Reprod Med.</i> 2007;52(9):757-761.	Observational-Dx	576 patients	To determine the association between endometrial stripe thickness and pregnancy outcome in women with a symptomatic first-trimester pregnancy and to determine how vaginal bleeding, pelvic pain and hCG level affect endometrial stripe thickness.	Endometrial stripe was thinner with increased vaginal bleeding and associated with hCG level and pregnancy outcome. The mean endometrial stripe for ectopic pregnancies was 9.56 +/- 4.87, for IUPs was 12.12 +/- 6.0 and for spontaneous abortion was 10.19 +/- 6.10. 99% of patients with ectopic pregnancies had an ES <21 mm, and 100% had one <25 mm.	3
4. Cacciatore B. Can the status of tubal pregnancy be predicted with transvaginal sonography? A prospective comparison of sonographic, surgical, and serum hCG findings. <i>Radiology.</i> 1990;177(2):481-484.	Observational-Dx	120 patients	Prospective comparison of sonographic, surgical and serum hCG findings to determine if the status of tubal pregnancy can be predicted with TVU.	Tubal pregnancy status can be predicted reliably on the basis of TVU findings.	3
5. Goldstein SR, Snyder JR, Watson C, Danon M. Very early pregnancy detection with endovaginal ultrasound. <i>Obstet Gynecol.</i> 1988;72(2):200-204.	Review/Other-Dx	235 patients	Prospective study to observe imaging of early pregnancy with US.	Imaging of normal pregnancies is possible when: Sac is >0.4 cm; hCG is >1025 mIU/mL; Uterus is normal with a homogeneous echo pattern.	4

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6. Nyberg DA, Mack LA, Laing FC, Jeffrey RB. Early pregnancy complications: endovaginal sonographic findings correlated with human chorionic gonadotropin levels. <i>Radiology</i> . 1988;167(3):619-622.	Observational-Dx	84 patients	To correlate endovaginal US findings with hCG levels in early pregnancy complications.	Intrauterine gestational sac should be visualized with endovaginal US when the hCG level exceeds 1,000 IU/L. Visualization of an extrauterine gestational sac and/or adnexal mass is likely in ectopic pregnancies when hCG level exceeds 1,000 IU/L.	3
7. Braffman BH, Coleman BG, Ramchandani P, et al. Emergency department screening for ectopic pregnancy: a prospective US study. <i>Radiology</i> . 1994;190(3):797-802.	Observational-Dx	1,427 consecutive patients	Prospective analysis of pelvic sonograms to determine the effectiveness of pelvic sonography as a screening test for ectopic pregnancy.	Sonograms were diagnostic in 1,158 patients and indeterminate in 269. When indeterminate studies were considered falsely negative, the diagnostic accuracy was 81%. Sensitivity and specificity of screening US for ectopic pregnancy were 99% and 84%, respectively. Pelvic sonography is an effective screening test for ectopic pregnancy.	3
8. Mehta TS, Levine D, Beckwith B. Treatment of ectopic pregnancy: is a human chorionic gonadotropin level of 2,000 mIU/mL a reasonable threshold? <i>Radiology</i> . 1997;205(2):569-573.	Observational-Dx	676 patients	Retrospective study to determine whether a hCG level of 2,000 mIU/mL is a reasonable threshold for diagnosing ectopic pregnancy in the absence of US findings of IUP and thus to prevent inappropriate treatment that will result in the loss of an otherwise normal pregnancy in women with early IUP.	548 patients had evidence of a normal or abnormal IUP. 51 patients (40%) of the 128 patients without evidence of an IUP had an hCG level >2,000 mIU/mL. Of these 51 patients, 15 (29%) were treated for ectopic pregnancy; 17 (33%) were not immediately treated for ectopic pregnancy and had a normal IUP at follow-up US. An hCG level of 2,000 mIU/mL without US findings of IUP, while suggestive of an abnormal pregnancy, is not diagnostic. Per the results of recent studies, it is reasonable to closely follow-up rather than treat many of these early, stable cases of ectopic pregnancy.	3

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9. Barnhart KT, Fay CA, Suescum M, et al. Clinical factors affecting the accuracy of ultrasonography in symptomatic first-trimester pregnancy. <i>Obstet Gynecol.</i> 2011;117(2 Pt 1):299-306.	Observational-Dx	1,880 women	To evaluate factors associated with accuracy of initial US in patients with symptomatic first-trimester pregnancy.	1,880 women were evaluated. Overall accuracy of initial US diagnosis was 78%. A probable US diagnosis of ectopic pregnancy (adnexal mass without the presence of a yolk sac or embryo) resulted in a higher sensitivity (42.1% compared with 13.2%; $P<.001$ ) but a lower PPV (82.7% compared with 98%; $P<.01$ ) compared with a definite diagnosis. A probable US diagnosis of IUP (double decidual sign without yolk sac or embryo) resulted in a higher sensitivity (36.0% compared with 4.0%; $P<.001$ ) and lower PPV (58.8% compared with 87.0%; $P>.001$ ) compared with a definite diagnosis. The sensitivity (34.3% compared with 75.9%; $P<.01$ ) and PPV (80.4% compared with 91.5%; $P=.02$ ) were lower for diagnosis of ectopic pregnancy when serum hCG level was $<2,000$ mIU/mL. US was less accurate when bleeding was the chief complaint (72.7% compared with 84.8% $P<.006$ ) but not substantially altered by pain as a chief complaint (78.0% compared with 77.8% $P>.99$ ).	3
10. Connolly A, Ryan DH, Stuebe AM, Wolfe HM. Reevaluation of discriminatory and threshold levels for serum beta-hCG in early pregnancy. <i>Obstet Gynecol.</i> 2013;121(1):65-70.	Review/Other-Dx	651 pregnancies	To reevaluate both discriminatory and threshold levels associated with visualization of gestational sacs, yolk sacs, and fetal poles in patients presenting with vaginal bleeding, pain, or vaginal bleeding and pain in the first trimester of pregnancy using current US technology.	651 pregnancies met inclusion criteria; 366 were viable. Discriminatory beta-hCG levels at which structures would be predicted to be seen 99% of the time were 3,510 mIU/mL, 17,716 mIU/mL, and 47,685 mIU/mL for gestational sac, yolk sac, and fetal pole, respectively. In this population, threshold values for beta-hCG levels at which these structures could be seen were 390 mIU/mL, 1,094 mIU/mL, and 1,394 mIU/mL, respectively.	4
11. Doubilet PM, Benson CB, Bourne T, Blaivas M. Diagnostic criteria for nonviable pregnancy early in the first trimester. <i>Ultrasound Q.</i> 2014;30(1):3-9.	Review/Other-Dx	N/A	Diagnostic criteria for nonviable pregnancy early in the first trimester.	No results stated in abstract.	4
12. Doubilet PM, Benson CB, Bourne T, et al. Diagnostic criteria for nonviable pregnancy early in the first trimester. <i>N Engl J Med.</i> 2013;369(15):1443-1451.	Review/Other-Dx	N/A	Diagnostic criteria for nonviable pregnancy early in the first trimester.	No results stated in abstract.	4

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13. Levine D. Ectopic Pregnancy. In: Callen PW, ed. <i>Ultrasonography in Obstetrics and Gynecology</i> . 5th ed. Philadelphia, PA: Saunders; 2008:1034.	Review/Other-Dx	N/A	Book chapter.	N/A	4
14. Crochet JR, Bastian LA, Chireau MV. Does this woman have an ectopic pregnancy?: the rational clinical examination systematic review. <i>JAMA</i> . 2013;309(16):1722-1729.	Review/Other-Dx	14 studies with 12,101 patients	To systematically review the accuracy and precision of the patient history, clinical examination, readily available laboratory values, and sonography in the diagnosis of ectopic pregnancy in women with abdominal pain or vaginal bleeding during early pregnancy.	All components of the patient history had a LR+ <1.5. The presence of an adnexal mass in the absence of an IUP on TVU (LR+ 111; 95% CI, 12–1028; n = 6,885), and the physical examination findings of cervical motion tenderness (LR+ 4.9; 95% CI, 1.7–14; n = 1,435), an adnexal mass (LR+ 2.4; 95% CI, 1.6–3.7; n = 1,378), and adnexal tenderness (LR+ 1.9; 95% CI, 1.0–3.5; n = 1,435) all increase the likelihood of ectopic pregnancy. A lack of adnexal abnormalities on TVU (LR- 0.12; 95% CI, 0.03–0.55; n = 6,885) decreases the likelihood of ectopic pregnancy. Existing studies do not establish a single serum hCG level that is diagnostic of ectopic pregnancy.	4
15. Patel MD, Feldstein VA, Filly RA. The likelihood ratio of sonographic findings for the diagnosis of hemorrhagic ovarian cysts. <i>J Ultrasound Med</i> . 2005;24(5):607-614; quiz 615.	Observational-Dx	252 masses	To quantify the LR of US findings for the diagnosis of a hemorrhagic ovarian cyst.	Fibrin strands and a retracting clot are important in the diagnosis of a hemorrhagic ovarian cyst. About 90% of cysts will exhibit at least 1 of these 2 features.	1
16. Alcazar JL, Guerriero S, Laparte C, Ajossa S, Ruiz-Zambrana A, Melis GB. Diagnostic performance of transvaginal gray-scale ultrasound for specific diagnosis of benign ovarian cysts in relation to menopausal status. <i>Maturitas</i> . 2011;68(2):182-188.	Observational-Dx	2,146 adnexal masses in 1,980 women (1,420 premenopausal and 560 postmenopausal)	To assess the diagnostic accuracy of TVU for assigning a specific diagnosis to benign adnexal masses in pre- and postmenopausal women.	Sensitivity and specificity for each diagnosis were calculated in both pre- and postmenopausal women. Specificity for malignant tumors was significantly higher in premenopausal women ( $P<0.001$ ). Sensitivity for endometrioma ( $P<0.05$ ) and hemorrhagic cyst ( $P<0.01$ ) was significantly higher in premenopausal women. There was a trend for a higher sensitivity for serous cyst in postmenopausal women ( $P=0.09$ ).	3
17. Timor-Tritsch IE, Lerner JP, Monteagudo A, Murphy KE, Heller DS. Transvaginal sonographic markers of tubal inflammatory disease. <i>Ultrasound Obstet Gynecol</i> . 1998;12(1):56-66.	Observational-Dx	77 patients	To identify sonographic markers of inflammatory disease of the pelvis.	Tube-ovarian complex and the TOA can be differentiated with TVU.	3

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18. Molander P, Sjoberg J, Paavonen J, Cacciatore B. Transvaginal power Doppler findings in laparoscopically proven acute pelvic inflammatory disease. <i>Ultrasound Obstet Gynecol.</i> 2001;17(3):233-238.	Observational-Dx	30 study groups, 20 reference groups	To assess the usefulness of Doppler TVU in diagnosing PID. To assess the diagnostic reliability of specific sonographic findings.	Overall accuracy of Doppler TVU was 93%.	3
19. Romosan G, Bjartling C, Skoog L, Valentin L. Ultrasound for diagnosing acute salpingitis: a prospective observational diagnostic study. <i>Hum Reprod.</i> 2013;28(6):1569-1579.	Observational-Dx	52 patients	Aim of study is (i) to describe US findings in cases of acute mild, moderate and severe salpingitis verified by laparoscopy and (ii) to estimate the sensitivity and specificity of TVU for diagnosing acute salpingitis in patients with clinical signs of PID.	Of the 52 patients, 23 (44%) had a final diagnosis unrelated to genital infection, while the other 29 had cervicitis (n = 3), endometritis (n = 9) or salpingitis (n = 17; mild n = 4, moderate n = 8, severe, ie, pyosalpinx n = 5). Bilateral adnexal masses and bilateral masses lying adjacent to the ovary were seen more often on US in patients with salpingitis than with other diagnoses (bilateral adnexal masses: 82 vs 17%, ie, 14/17 vs 6/35, $P=0.000$ , positive LR 4.8, negative LR 0.22; bilateral masses adjacent to ovary: 65 vs 17%, ie, 11/17 vs 6/35, $P=0.001$ , positive LR 3.8, negative LR 0.42). In cases of salpingitis, the masses lying adjacent to the ovaries were on average 2–3 cm in diameter, solid (n = 14), unilocular cystic (n = 4), multilocular cystic (n = 3) or multilocular solid (n = 1), with thick walls and well vascularized at color Doppler. In no case were the cogwheel sign or incomplete septae seen. All 13 cases of moderate or severe salpingitis were diagnosed with US (detection rate 100%, 95% CI, 78%–100%) compared with 1 of 4 cases of mild salpingitis. 3 of 6 cases of appendicitis, and 2 of 2 ovarian cysts were correctly diagnosed with US, and 1 case of adnexal torsion was suspected and then verified at laparoscopy.	2
20. Lee DC, Swaminathan AK. Sensitivity of ultrasound for the diagnosis of tubo-ovarian abscess: a case report and literature review. <i>J Emerg Med.</i> 2011;40(2):170-175.	Review/Other-Dx	1 woman	To review the sensitivity and specificity of US for the diagnosis of TOA through a case report and literature review.	The authors found evidence for lower sensitivity and specificity of US for the diagnosis of TOA than generally reported in the emergency medicine literature.	4

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21. Mashiach R, Melamed N, Gilad N, Ben-Shitrit G, Meizner I. Sonographic diagnosis of ovarian torsion: accuracy and predictive factors. <i>J Ultrasound Med.</i> 2011;30(9):1205-1210.	Observational-Dx	63 women	To determine the accuracy of sonographic diagnosis of ovarian torsion and the predictive value of typical sonographic signs.	Sonography had diagnostic accuracy of 74.6% for ovarian torsion. Abnormal ovarian blood flow and the presence of free fluid were the most diagnostically accurate isolated sonographic signs (PPVs, 80.0% and 89.2%, respectively; NPVs, 46.2% and 46.2%). Using combinations of sonographic signs yielded higher specificity and PPVs and lower sensitivity and NPVs for ovarian torsion. The diagnostic accuracy was largely affected by the US operator (mean +/- SD, 78.8% +/- 16.0%; range, 60.0%–100%).	3
22. Varras M, Polyzos D, Perouli E, Noti P, Pantazis I, Akrivis C. Tubo-ovarian abscesses: spectrum of sonographic findings with surgical and pathological correlations. <i>Clin Exp Obstet Gynecol.</i> 2003;30(2-3):117-121.	Review/Other-Dx	25 women	To identify the different sonographic markers on gray scale and color Doppler sonography in TOAs.	Presence of a mass was found in all cases. The maximum diameter of the mass was 5 cm in 2 cases and between 5 cm and 10 cm in 23 cases. The mass was demonstrated at the anatomic position of the ovary in 21 cases (84%) and at the cul-de-sac in 4 cases (16%). The mass was a simple cyst in 2 cases (8%), in 4 cases it was cystic with diaphragms (16%), in 4 cases it was a thickened tube-shaped structure with multiple internal echoes (16%) and in 15 cases it was a mixture of cystic and solid elements (60%). Pyosalpinges with fluid-fluid levels were found in 2 cases. Fluid in the cul-de-sac was observed at a rate of 48%. Color Doppler sonography demonstrated abundant blood flow in the borders and the septa of the TOAs in 90% of the studied cases.	4
23. Gjelland K, Granberg S, Kiserud T, Wentzel-Larsen T, Ekerhovd E. Pregnancies following ultrasound-guided drainage of tubo-ovarian abscess. <i>Fertil Steril.</i> 2012;98(1):136-140.	Review/Other-Tx	100 women	To study fertility among women treated by means of US-guided drainage and antibiotics for TOA.	20/38 (52.6%; 95% CI, 36.5%–68.9%) women who intended to have a child achieved pregnancy naturally and became mothers. In addition, 7 (50%) of 14 women who were not on birth control on a regular basis became pregnant. No ectopic pregnancies were registered.	4

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24. Linam LE, Darolia R, Naffaa LN, et al. US findings of adnexal torsion in children and adolescents: size really does matter. <i>Pediatr Radiol.</i> 2007;37(10):1013-1019.	Observational-Dx	61 menarchal subjects: 33 cases and 28 controls	To determine which sonographic findings can predict adnexal torsion by comparing pediatric and adolescent patients with surgically confirmed torsion (cases) to those without torsion (controls).	The authors identified 61 menarchal subjects: 33 cases and 28 controls. Adnexal volume was larger in cases than in controls (185 vs 37.8 ml, $P<0.001$ ). A volume of $>75$ ml was more common in cases than in controls (64 vs 15%, $P<0.001$ ). No cases had an adnexal volume of $<20$ ml ( $P<0.001$ ). The adnexal ratio was larger in cases than in controls (16.1 vs 6.7, $P<0.001$ ). An adnexal ratio of $>15$ was seen in 40% of cases and in no controls ( $P=0.08$ ). Doppler US results were not predictive of torsion.	3
25. Wood MM, Romine LE, Lee YK, et al. Spectral Doppler signature waveforms in ultrasonography: a review of normal and abnormal waveforms. <i>Ultrasound Q.</i> 2010;26(2):83-99.	Review/Other-Dx	N/A	Review article to explain the physics behind Doppler US and some of the most common mathematical equations applied in a routine clinical examination. The authors also describe and demonstrate normal vs abnormal spectral Doppler signature waveforms of vessels in the neck, abdomen, pelvis, and fetus.	No results stated in abstract.	4
26. Shadinger LL, Andreotti RF, Kurian RL. Preoperative sonographic and clinical characteristics as predictors of ovarian torsion. <i>J Ultrasound Med.</i> 2008;27(1):7-13.	Observational-Dx	39 patients	Retrospective review to determine sonographic and clinical characteristics of ovarian torsion.	Ovarian enlargement is the most commonly associated sonographic finding.	3
27. Chiou SY, Lev-Toaff AS, Masuda E, Feld RI, Bergin D. Adnexal torsion: new clinical and imaging observations by sonography, computed tomography, and magnetic resonance imaging. <i>J Ultrasound Med.</i> 2007;26(10):1289-1301.	Observational-Dx	58 patients	To review the clinical, imaging, and pathologic findings associated with adnexal torsion. Imaging reports were assessed to determine whether a correct preoperative diagnosis was made.	Common imaging findings were adnexal mass (65% on US, 87% on CT, and 75% on MRI), a displaced adnexal mass/enlarged ovary (53% on US, 87% on CT, and 75% on MRI), and ascites (53% on US, 73% on CT, and 50% on MRI). A correct preoperative diagnosis was made by initial US in 15 (71%) of 21 cases vs initial CT in 5 (38%) of 13. A correct imaging diagnosis was made more frequently in premenopausal than in menopausal patients ( $P=.02$ ) and in patients without an underlying adnexal mass compared with those with a mass ( $P=.05$ ). Although CT shows features suggestive of torsion, the diagnostic value of initial CT was less than that of initial US in this study.	3

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28. Nizar K, Deutsch M, Filmer S, Weizman B, Beloosesky R, Weiner Z. Doppler studies of the ovarian venous blood flow in the diagnosis of adnexal torsion. <i>J Clin Ultrasound</i> . 2009;37(8):436-439.	Observational-Dx	199 patients	To evaluate the role of ovarian Doppler studies in diagnosing adnexal torsion.	Sensitivity and specificity of tissue edema, absence of intra-ovarian vascularity, absence of arterial flow, and absence or abnormal venous flow in the diagnosis of adnexal torsion were: 21% and 100%, 52% and 91%, 76% and 99%, and 100% and 97%, respectively. Abnormal ovarian venous flow may be the only abnormal US sign observed during the early stage of adnexal torsion.	3
29. Kupesic S, Plavsic BM. Adnexal torsion: color Doppler and three-dimensional ultrasound. <i>Abdom Imaging</i> . 2010;35(5):602-606.	Observational-Dx	36 patients	To correlate preoperative US and color Doppler findings in patients with surgically proven adnexal torsion.	2-D color Doppler US detected the absence of blood flow signals in the pedicles of 21 patients with complete adnexal torsion. Presence of the arterial blood flow signals within the pedicle alone was detected in 3 patients and was predictive of a nonviable ovary. The ovarian artery and vein were demonstrated in 10 patients with partial torsion. Venous signals alone were isolated in 2 patients with partial adnexal torsion. 3-D power Doppler indices of partially twisted adnexa following detorsion have improved significantly 1 ( $P<0.05$ ) and 3 months ( $P<0.05$ ), respectively, reaching normal intra-ovarian perfusion values.	3
30. Navve D, Hershkovitz R, Zetounie E, Klein Z, Tepper R. Medial or lateral location of the whirlpool sign in adnexal torsion: clinical importance. <i>J Ultrasound Med</i> . 2013;32(9):1631-1634.	Review/Other-Dx	30 patients	To describe the location of the whirlpool sign (lateral or medial to the ovary) and to evaluate the clinical importance of the location.	16/30 patients had right-sided torsion. Of these, 7 had a lateral whirlpool sign. All 7 of these patients had an ovarian or paraovarian mass. 9 of these 16 patients had a medial whirlpool sign. Of these, 7 had an ovarian or paraovarian mass, and 2 had no mass. Of the 14 patients with left-sided torsion, all had a medial whirlpool sign. 9/14 these patients had an ovarian or paraovarian mass, and 5 had no mass. The mean volume of the masses among cases with the lateral whirlpool sign was significantly greater compared to those with the medial whirlpool sign (304 vs 108 cm <sup>3</sup> ); $P=.035$ ). In 25/30 cases, the torsed components included the ovary.	4

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31. Valsky DV, Esh-Broder E, Cohen SM, Lipschuetz M, Yagel S. Added value of the gray-scale whirlpool sign in the diagnosis of adnexal torsion. <i>Ultrasound Obstet Gynecol.</i> 2010;36(5):630-634.	Observational-Dx	80 women	To evaluate the efficacy of the whirlpool sign in the diagnosis of torsion, as compared to a protocol based on 'classic' sonographic signs of torsion alone.	80 women were referred for laparoscopy for suspected adnexal torsion during the study period. In 22 women the ultrasound investigation had included the whirlpool sign (study group) while 58 had been examined by the standard protocol (control group). Twenty women in the study group had a positive whirlpool sign on ultrasound, 18 of whom (90.0%) had confirmed torsion on laparoscopy. In the control group 32 of 58 (55.2%) women had confirmed torsion on laparoscopy.	3
32. Doria AS, Moineddin R, Kellenberger CJ, et al. US or CT for Diagnosis of Appendicitis in Children and Adults? A Meta-Analysis. <i>Radiology.</i> 2006;241(1):83-94.	Meta-analysis	Children: 26 studies, 9,356 patients, Adults: 31 studies, 4,341 patients	To perform a meta-analysis to evaluate the diagnostic performance of US and CT for the diagnosis of appendicitis in pediatric and adult populations.	Children: Sensitivity of 88% (95% CI: 86%, 90%) and specificity of 94% (95% CI: 92%, 95%), for US studies and sensitivity of 94% (95% CI: 92%, 97%) and specificity of 95% (95% CI: 94%, 97%) for CT studies. Adults: Pooled sensitivity and specificity for diagnosis were 83% (95% CI: 78%, 87%) and 93% (95% CI: 90%, 96%), respectively, for US studies and 94% (95% CI: 92%, 95%) and 94% (95% CI: 94%, 96%), respectively, for CT studies. CT had higher sensitivity and specificity than US. From a safety perspective, US should be considered initially in children.	M
33. Williams R, Shaw J. Ultrasound scanning in the diagnosis of acute appendicitis in pregnancy. <i>Emerg Med J.</i> 2007;24(5):359-360.	Review/Other-Dx	3 papers	A short cut review was performed to establish whether US has valuable clinical utility in pregnant women with suspected appendicitis.	A positive US scan may be useful in the diagnosis of acute appendicitis during pregnancy. Those patients with a negative scan should be further investigated and observed until the symptoms resolve or an alternative diagnosis is reached.	4

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34. Aranda-Narvaez JM, Montiel-Casado MC, Gonzalez-Sanchez AJ, et al. [Radiological support for diagnosis of acute appendicitis: use, effectiveness and clinical repercussions]. <i>Cir Esp</i> . 2013;91(9):574-578.	Observational-Dx	Study group = 419: control group = 237	To analyze the increasing need of radiological support in the diagnosis of acute appendicitis, the clinical repercussions associated, and the parameters of diagnostic accuracy of US and CT scan for acute appendicitis.	Age, gender, percentage of atypical locations and gangrenous/perforated episodes were similar in both groups. The number of radiological examinations needed for diagnosis was significantly higher in the study group (78.8% vs 30.4%, $P < .000$ ). Sensitivity was significantly superior for CT than for US (97% vs 86%), but PPV was similar in both tests (92% vs 94%). Surgical exploration percent values with diagnosis of acute appendicitis was significantly higher in the study group (94.5% vs 88.6%; $P < .006$ , OR 2.2; CI 95% 1.25-4).	3
35. Miloudi N, Brahem M, Ben Abid S, Mzoughi Z, Arfa N, Tahar Khalfallah M. Acute appendicitis in pregnancy: specific features of diagnosis and treatment. <i>J Visc Surg</i> . 2012;149(4):e275-279.	Review/Other-Dx	29 pregnant women	To present a series of pregnant women who underwent surgery for acute appendicitis over a period of 10 years.	The postoperative course was uncomplicated in 27 patients. 2 patients miscarried in the week following surgery. Acute appendicitis puts both maternal and fetal prognosis at risk. Management should be prompt and undertaken by a multidisciplinary team approach. Morbidity and mortality are not negligible.	4
36. Lehnert BE, Gross JA, Linnau KF, Moshiri M. Utility of ultrasound for evaluating the appendix during the second and third trimester of pregnancy. <i>Emerg Radiol</i> . 2012;19(4):293-299.	Observational-Dx	99 consecutive pregnant women	To retrospectively evaluate the right lower quadrant USs in women presenting during the second or third trimester of pregnancy for the frequency of appendix visualization and accuracy in diagnosing appendicitis.	The appendix was not visualized in 97% (96/99) of right lower quadrant US examinations. Of the 3 studies in which the appendix was visualized, 2 were considered positive for appendicitis and 1 was considered negative. 8 patients in this group ultimately underwent appendectomy, including the 2 patients with positive right lower quadrant USs, and appendicitis confirmed at pathology in 7 of these cases (87.5%). Right lower quadrant US successfully demonstrated an abnormal appendix in 28.7% (2 of 7) of surgically confirmed cases; however, this technique did not detect appendicitis in 71% (5 of 7) of patients with surgically proven disease due to nonvisualization of the appendix.	3

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37. Sheafor DH, Hertzberg BS, Freed KS, et al. Nonenhanced helical CT and US in the emergency evaluation of patients with renal colic: prospective comparison. <i>Radiology</i> . 2000;217(3):792-797.	Observational-Dx	45 patients	Prospective comparison of nonenhanced helical CT and US for the depiction of urolithiasis.	Diagnoses included 23 ureteral calculi and 1 each of renal cell carcinoma, appendicitis, ureteropelvic junction obstruction, renal subcapsular hematoma, cholelithiasis, medullary calcinosis, and myelolipoma. CT depicted 22/23 ureteral calculi (sensitivity, 96%). US depicted 14/23 ureteral calculi (sensitivity, 61%). Differences in sensitivity were statistically significant (P=.02). Specificity for each technique was 100%. When modalities were compared for the detection of any clinically relevant abnormality (eg, unilateral hydronephrosis and/or urolithiasis in patients with an obstructing calculus), sensitivities of US and CT increased to 92% and 100%, respectively. One case of appendicitis was missed at US, whereas medullary calcinosis and myelolipoma were missed at CT.	1
38. Ulsan S, Koc Z, Tokmak N. Accuracy of sonography for detecting renal stone: comparison with CT. <i>J Clin Ultrasound</i> . 2007;35(5):256-261.	Observational-Dx	50 patients	To determine accuracy of US in the detection of renal stones using noncontrast CT as the gold standard.	The sensitivity of sonography for any stone in a patient was 52-57% for the right kidney (radiologist 1 and 2) and 32-39% for the left kidney (radiologist 1 and 2). The overall accuracy of sonography in detecting a stone in the right kidney by radiologists 1 and 2 was 67% and 77%, respectively. The corresponding accuracy values for the left kidney were 53% and 54%, respectively.	2
39. White WM, Johnson EB, Zite NB, et al. Predictive value of current imaging modalities for the detection of urolithiasis during pregnancy: a multicenter, longitudinal study. <i>J Urol</i> . 2013;189(3):931-934.	Observational-Dx	51 pregnant patients	To determine the optimal imaging study by which to diagnose and treat pregnant patients with suspected urolithiasis.	Of the 51 women, 24 (47%) underwent renal US and low dose CT, 22 (43%) underwent US alone, and 5 (10%) underwent renal US and MRU. Negative ureteroscopy occurred in 7/51 patients (14%). The rate of negative ureteroscopy among patients who underwent renal US alone, renal US and low dose CT, and renal US and MRU was 23%, 4.2%, and 20%, respectively. The PPV of CT, MRI and US was 95.8%, 80% and 77%, respectively.	4

**Acute Pelvic Pain in the Reproductive Age Group  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
40. Elwagdy S, Ghoneim S, Moussa S, Ewis I. Three-dimensional ultrasound (3D US) methods in the evaluation of calcular and non-calicular ureteric obstructive uropathy. <i>World J Urol.</i> 2008;26(3):263-274.	Observational-Dx	318 patients	To prospectively assess ureteric obstructive uropathy using 3D US methods when the etiology of ureteral obstruction was proved difficult to evaluate with 2D US and plain radiography.	The study showed a high accuracy of detection of different levels of ureteric calcular obstruction; 99.1% in men and 96.7% in women. 3D XI technology proved more efficient in stone count (88.9%) than sectional planes and rendering method altogether (55.6%). The success rate of identifying obstructive uropathy due to inflammatory variants showed a perfect diagnostic value of 100%. Similar percentages could be obtained in cases secondary to neoplastic infiltration or permeation of the ureters. Cases compared with excretory urography revealed close correlation with 3D US and superiority of the latter when renal function physiologically altered in some cases of calcular obstructive uropathy.	3
41. Lazarus E, Mayo-Smith WW, Mainiero MB, Spencer PK. CT in the evaluation of nontraumatic abdominal pain in pregnant women. <i>Radiology.</i> 2007;244(3):784-790.	Observational-Dx	80 consecutive CT scans performed in 78 pregnant women	To retrospectively determine accuracy of CT for the diagnosis of appendicitis and compare findings of CT and US.	CT findings established the diagnosis in 35% of examinations with a NPV of 99%; when CT followed negative US findings, CT findings established the diagnosis in 30% of patients.	3
42. Raman SS, Lu DS, Kadell BM, Vodopich DJ, Sayre J, Cryer H. Accuracy of nonfocused helical CT for the diagnosis of acute appendicitis: a 5-year review. <i>AJR Am J Roentgenol.</i> 2002;178(6):1319-1325.	Observational-Dx	650: 552 with adequate follow-up for inclusion in analysis	Multi-year review of accuracy of CT for diagnosis of acute appendicitis.	Very high accuracy for CT for presence or absence of appendicitis and identification of alternate diagnosis in 66% of cases.	3
43. Rao PM, Feltmate CM, Rhea JT, Schulick AH, Novelline RA. Helical computed tomography in differentiating appendicitis and acute gynecologic conditions. <i>Obstet Gynecol.</i> 1999;93(3):417-421	Observational-Dx	100 consecutive patients	Prospective study to determine the accuracy and effect of helical CT in women clinically suspected of having either appendicitis or an acute gynecologic condition.	Helical CT is excellent for differentiating appendicitis from most acute gynecologic conditions. 32 women had appendicitis, 15 had acute gynecologic conditions, 27 had other specific diagnoses, and 26 had nonspecific abdominal pain. Appendicitis CT; sensitivity 100%, specificity 87%. Other acute gynecologic conditions CT: sensitivity 87%, 100% specificity.	3

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
44. Wallace CA, Petrov MS, Soybel DI, Ferzoco SJ, Ashley SW, Tavakkolizadeh A. Influence of imaging on the negative appendectomy rate in pregnancy. <i>J Gastrointest Surg.</i> 2008;12(1):46-50.	Observational-Dx	86 pregnant women	Retrospective study to evaluate the probability of US and CT in diagnosing appendicitis in pregnancy, as reflected in the negative appendectomy rate.	Clinical evaluation group had 13 patients, with a negative appendectomy rate of 54% (7/13). 55 patients underwent an US alone, with a negative appendectomy rate 36% (20/55). In the US/CT group (n=13), the negative appendectomy rate was 8% (1/13). There was a significant reduction in the negative appendectomy rate in the US/CT scan group compared to clinical evaluation group (54% vs 8%, $P<0.05$ ). This reduction was not achieved in the US group when compared to the clinical evaluation group or the US/CT group ( $P=0.05$ ). A significant reduction was achieved when the US/CT group was compared to the patients in the US only group who had a normal or inconclusive US ( $P<0.05$ ). Authors recommend an US followed by a CT scan in patients with a normal or inconclusive US.	3
45. Shetty MK, Garrett NM, Carpenter WS, Shah YP, Roberts C. Abdominal computed tomography during pregnancy for suspected appendicitis: a 5-year experience at a maternity hospital. <i>Semin Ultrasound CT MR.</i> 2010;31(1):8-13.	Observational-Dx	39 pregnant patients	To evaluate the role of CT in a pregnant patient with right lower quadrant pain in whom there was a clinical suspicion of acute appendicitis.	The sensitivity of CT in the diagnosis of appendicitis in the study group was 100%, compared with a sensitivity of 46.1% for US. CT provides an accurate diagnosis in patients suspected to have acute appendicitis and is of value in avoiding false negative exploratory laparotomy with its consequent risk of maternal and fetal mortality and morbidity. Although sonography is the preferred initial imaging modality as its lack of ionizing radiation, CT is more accurate in providing a timely diagnosis and its use is justified to reduce maternal mortality and mortality in patients with appendicitis.	3
46. van Randen A, Bipat S, Zwinderman AH, Ubbink DT, Stoker J, Boermeester MA. Acute appendicitis: meta-analysis of diagnostic performance of CT and graded compression US related to prevalence of disease. <i>Radiology.</i> 2008;249(1):97-106.	Meta-analysis	6 studies; 671 patients	Meta-analysis of diagnostic performance of CT and graded compression US to diagnose acute appendicitis.	CT had a better test performance than did graded compression US in diagnosing appendicitis. Ignoring the relationship between prevalence (pretest probability) and diagnostic value may lead to an inaccurate estimation of diagnostic performance..	M

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
47. Kim HC, Yang DM, Kim SW, Park SJ. Reassessment of CT images to improve diagnostic accuracy in patients with suspected acute appendicitis and an equivocal preoperative CT interpretation. <i>Eur Radiol.</i> 2012;22(6):1178-1185.	Review/Other-Dx	53 patients	To identify CT features that discriminate individuals with and without acute appendicitis in patients with equivocal CT findings, and to assess whether knowledge of these findings improves diagnostic accuracy.	CT findings found to be significantly different in the 2 groups were; the presence of appendiceal wall enhancement, intraluminal air in appendix, a coexistent inflammatory lesion, and appendiceal wall thickening ( $P<0.05$ ). Areas under the curves of reviewers 1 and 2 significantly increased from 0.516 and 0.706 to 0.677 and 0.841, respectively, when reviewers were told which CT variables were significant ( $P=0.0193$ and $P=0.0397$ , respectively).	4
48. Kaiser AM, Jiang JK, Lake JP, et al. The management of complicated diverticulitis and the role of computed tomography. <i>Am J Gastroenterol.</i> 2005;100(4):910-917.	Observational-Dx	511 patients	Retrospective study to define the role of CT and analyze its impact on the management of acute diverticulitis.	CT evidence of a diverticular abscess correlates with high risk of failure from nonoperative management.	3
49. Kim BS, Hwang IK, Choi YW, et al. Low-dose and standard-dose unenhanced helical computed tomography for the assessment of acute renal colic: prospective comparative study. <i>Acta Radiol.</i> 2005;46(7):756-763.	Observational-Dx	121 patients	Prospective study to compare the efficacy of low-dose and standard-dose CT for the diagnosis of ureteral stones.	Compared with standard scans using 260 mAs, low-dose CT using 50 mAs results in 81% decrease in radiation dose.	2
50. Poletti PA, Platon A, Rutschmann OT, Schmidlin FR, Iselin CE, Becker CD. Low-dose versus standard-dose CT protocol in patients with clinically suspected renal colic. <i>AJR Am J Roentgenol.</i> 2007;188(4):927-933.	Observational-Dx	125 patients	To compare a low-dose CT protocol with standard-dose unenhanced CT in patients with suspected renal colic.	Low-dose CT has sensitivities and specificities close to those of standard-dose CT. In patients with a body mass index of $<30$ , low-dose CT achieved 96% sensitivity and 100% specificity for the detection of indirect signs of renal colic and a sensitivity of 95% and a specificity of 97% for detecting ureteral calculi. Low-dose CT was 86% sensitive for detecting ureteral calculi $<3$ mm and 100% sensitive for detecting calculi $>3$ mm.	2
51. Niemann T, Kollmann T, Bongartz G. Diagnostic performance of low-dose CT for the detection of urolithiasis: a meta-analysis. <i>AJR Am J Roentgenol.</i> 2008;191(2):396-401.	Meta-analysis	7 studies with 1061 patients	A meta-analysis evaluating low-dose CT ( $<3$ mSv) for detection of urinary calculi.	Pooled sensitivity and specificity of low-dose CT for the diagnosis of urinary calculi were 0.966 and 0.949, respectively.	M

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
52. White WM, Zite NB, Gash J, Waters WB, Thompson W, Klein FA. Low-dose computed tomography for the evaluation of flank pain in the pregnant population. <i>J Endourol.</i> 2007;21(11):1255-1260.	Review/Other-Dx	20 patients	The authors report their institution's experience using low-dose CT in the evaluation of pregnant patients with refractory flank pain.	Between April 2004 and December 2006, 20 patients with an average gestational age of 26.5 weeks presented to our institution with acute, refractory flank pain consistent with a diagnosis of urolithiasis. All patients underwent renal US evaluation before unenhanced CT of the abdomen and pelvis using a low-dose protocol. The average radiation exposure was 705.75 mrad (range 210–1372; SD +/- 338.66 mrad). Of the 20 patients, CT demonstrated urinary stones (1–12 mm) in 13. Of those patients with documented stones, 4 were treated conservatively, 2 underwent intrapartum stent placement, 5 had ureteroscopy with stone extraction, and 2 were treated postpartum.	4
53. Kim K, Kim YH, Kim SY, et al. Low-dose abdominal CT for evaluating suspected appendicitis. <i>N Engl J Med.</i> 2012;366(17):1596-1605.	Experimental-Dx	891 patients	To evaluate the rate of negative (unnecessary) appendectomy after low-dose vs standard-dose abdominal CT in young adults with suspected appendicitis.	The negative appendectomy rate was 3.5% (6 of 172 patients) in the low-dose CT group and 3.2% (6 of 186 patients) in the standard-dose CT group (difference, 0.3 percentage points; 95% CI, -3.8 to 4.6). The 2 groups did not differ significantly in terms of the appendiceal perforation rate (26.5% with low-dose CT and 23.3% with standard-dose CT, $P=0.46$ ) or the proportion of patients who needed additional imaging tests (3.2% and 1.6%, respectively; $P=0.09$ ).	1
54. Yildirim D, Ozturk O, Tutar O, et al. A new method for computer-assisted detection, definition and differentiation of the urinary calculi. <i>Ren Fail.</i> 2014;36(8):1278-1282.	Review/Other-Dx	48 patients	To specify the opacity characteristics of various types of calcified foci that develop through the urinary system by using an image analysis program.	According to thorough morphological parameters, there were statistically significant differences in the angle and Feret angle values between calculi and mimickers ( $P<0.001$ ). Multivariate logistical regression analysis showed that Minor Axis and Feret angle parameters can be used to distinguish between ureteric ( $P=0.003$ ) and kidney ( $P=0.001$ ) stones.	4

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
55. Jepperson MA, Cernigliaro JG, Ibrahim el SH, Morin RL, Haley WE, Thiel DD. In vivo comparison of radiation exposure of dual-energy CT versus low-dose CT versus standard CT for imaging urinary calculi. <i>J Endourol.</i> 2015;29(2):141-146.	Observational-Dx	200 consecutive dual-energy CT examinations	To compare the radiation exposure of dual-energy CT, standard single-energy CT, and low-dose renal stone protocol single-energy CT for the evaluation of nephrolithiasis in a single in vivo patient cohort.	Dual-energy CT performed at 80/140 kVp and 100/140 kVp did not produce a significant difference in radiation exposure compared with low-dose renal stone protocol single-energy CT ( $P=0.09$ and $0.18$ , respectively). Dual-energy CT performed at 80/140 kVp and 100/140 kVp produced an average 40% and 31%, respectively, reduction in radiation exposure compared with single-energy CT ( $P<0.001$ ). For patients imaged with the 100/140 kVp protocol, average values for images noise were higher in the low-dose renal stone protocol single-energy CT images compared with dual-energy CT images ( $P<0.001$ ) and there was no significant difference in image noise between dual-energy CT and single-energy CT images in the same patient ( $P=0.88$ ). Patients imaged with the 80/140 kVp protocol had equivocal image noise compared with low-dose renal stone protocol single-energy CT images ( $P=0.44$ ), however, dual-energy CT images had greater noise compared with single-energy CT images in the same patient ( $P<0.001$ ). Of the 75 patients included in the study, stone material was available for 16; dual-energy CT analysis correctly predicted stone composition in 15/16 patients (93%).	3
56. Soulen MC, Fishman EK, Goldman SM, Gatewood OM. Bacterial renal infection: role of CT. <i>Radiology.</i> 1989;171(3):703-707.	Observational-Dx	62 patients	Retrospective review of imaging studies of patients hospitalized for acute renal infections.	Abnormality more likely when fever $>72$ hours. CT better than US for diagnosis both abscess and pyelonephritis..	4

**Acute Pelvic Pain in the Reproductive Age Group  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
57. Zissin R, Osadchy A, Gayer G, Kitay-Cohen Y. Extrarenal manifestations of severe acute pyelonephritis: CT findings in 21 cases. <i>Emerg Radiol.</i> 2006;13(2):73-77.	Review/Other-Dx	21 CT examinations of 20 patients	To report the extrarenal CT findings in patients with acute pyelonephritis.	Results showed that renal abnormalities were seen on CT in all patients. In addition, ascites was detected in all women patients associated with subcutaneous edema in 5 of them. A thickened gallbladder wall was found in 19 cases, all were women, and periportal tracking and a dilated inferior vena cava in 17 CTs. Pleural effusion and thickened interlobular septa were present in 16 and 15 studies, respectively. Relevant laboratory findings included hypoalbuminemia in 14, elevated liver enzymes in 11, hypocholesterolemia in 9, and elevated lactate dehydrogenase levels in 6 cases.	4
58. Basili G, Romano N, Bimbi M, Lorenzetti L, Pietrasanta D, Goletti O. Postpartum ovarian vein thrombosis. <i>JSLs.</i> 2011;15(2):268-271.	Review/Other-Dx	1 woman	A case report on postpartum ovarian vein thrombosis.	Ovarian vein thrombosis should be considered in any woman in the postpartum period with lower abdominal pain, fever, and leucocytosis.	4
59. Loud PA, Katz DS, Bruce DA, Klippenstein DL, Grossman ZD. Deep venous thrombosis with suspected pulmonary embolism: detection with combined CT venography and pulmonary angiography. <i>Radiology.</i> 2001;219(2):498-502.	Observational-Dx	650: 308 with US gold standard used in analysis	Study to determine the frequency and location of DVT at CT venography after CT pulmonary angiography using US as gold standard.	Combined CT venography and pulmonary angiography can accurately depict the femoropopliteal deep veins. CT sensitivity 97% and specificity 100% for femoropopliteal thrombosis.	1
60. Anderson SW, Soto JA, Lucey BC, et al. Abdominal 64-MDCT for suspected appendicitis: the use of oral and IV contrast material versus IV contrast material only. <i>AJR Am J Roentgenol.</i> 2009;193(5):1282-1288.	Experimental-Dx	303 total patients: 151 randomized to group 1 and 152 randomized to group 2 reviewers	To compare the diagnostic accuracy of IV contrast-enhanced 64-MDCT with and without the use of oral contrast material in diagnosing appendicitis in patients with abdominal pain.	Group 1: Sensitivity 100%, specificity 97.1%. Group 2: Sensitivity 100%, specificity 97.1%. Similar characteristics were seen using with or without oral contrast.	1

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
61. Hill BC, Johnson SC, Owens EK, Gerber JL, Senagore AJ. CT scan for suspected acute abdominal process: impact of combinations of IV, oral, and rectal contrast. <i>World J Surg.</i> 2010;34(4):699-703.	Observational-Dx	661 patients	To evaluate the diagnostic accuracy of abdominal/pelvic CT with varying use of contrast agents in hospitalized patients.	Use of IV contrast alone was found in 54.2% of CT scans and was correct in 92.5% of cases. IV and oral contrast was used in 22.2% of CT scans and was 94.6% correct. Unenhanced imaging was performed in 16.2% and was correct in 92.5%. Oral contrast alone was used in 7.0% and was 93.5% correct. There was no significant difference in the ability to correctly diagnose a suspected acute abdominal process when enhanced CT imaging was compared to unenhanced ( $P>0.05$ ).	3
62. Naeger DM, Chang SD, Kolli P, Shah V, Huang W, Thoeni RF. Neutral vs positive oral contrast in diagnosing acute appendicitis with contrast-enhanced CT: sensitivity, specificity, reader confidence and interpretation time. <i>Br J Radiol.</i> 2011;84(1001):418-426.	Observational-Dx	200 patients with neutral and 200 with positive oral contrast	To compare the sensitivity, specificity, confidence and interpretation time of readers of differing experience in diagnosing acute appendicitis with contrast-enhanced CT using neutral vs positive oral contrast agents.	Average reader sensitivity was found to be 96% (range 91%–99%) with positive and 95% (89%–98%) with neutral oral contrast; specificity was 96% (92%–98%) and 94% (90%–97%). For each reader, no statistically significant difference was found between the 2 agents (sensitivities $P>0.6$ ; specificities $P>0.08$ ), in the area under the ROC curve (range 0.95–0.99) or in average interpretation times. In cases without appendicitis, positive oral contrast demonstrated improved appendix identification (average 90% vs 78%) and higher confidence scores for 3 readers. Average interpretation times showed no statistically significant differences between the agents.	2
63. Tamburrini S, Brunetti A, Brown M, Sirlin C, Casola G. Acute appendicitis: diagnostic value of nonenhanced CT with selective use of contrast in routine clinical settings. <i>Eur Radiol.</i> 2007;17(8):2055-2061.	Observational-Dx	536	To determine the (1) frequency with which nonenhanced CT permits conclusive diagnosis of acute appendicitis, (2) accuracy of nonenhanced CT when findings are conclusive, and (3) overall accuracy of a CT protocol consisting of nonenhanced CT with selective use of contrast.	Sensitivity, specificity, and PPV and NPV for diagnosis of acute appendicitis were (1) 90%, 96.0%, 84.8%, and 97.4% in patients with conclusive nonenhanced CT (n=404); (2) 95.6%, 92.3%, 73%, and 99% in patients with inconclusive nonenhanced CT followed by repeat CT with contrast; and (3) 91.3%, 95%, 82%, and 98% in all patients. The initial diagnosis of appendicitis may be made by nonenhanced CT in 75% of patients, with contrast administration reserved for inconclusive nonenhanced CT studies.	2
64. Rha SE, Byun JY, Jung SE, et al. CT and MR imaging features of adnexal torsion. <i>Radiographics.</i> 2002;22(2):283-294.	Review/Other-Dx	N/A	Retrospective studies on diagnosis of adnexal torsion with CT and MRI.	CT and MRI are useful imaging tools.	4

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
65. Hiller N, Appelbaum L, Simanovsky N, Lev-Sagi A, Aharoni D, Sella T. CT features of adnexal torsion. <i>AJR Am J Roentgenol.</i> 2007;189(1):124-129.	Review/Other-Dx	35 patients, 2 reviewers	Retrospective review of CT scans to define the CT features associated with adnexal torsion and to correlate these features with the clinical, sonographic, surgical, and pathologic findings.	On CT, a well-defined adnexal mass abnormally located in the pelvis with ipsilateral deviation of the uterus in a woman or girl with lower abdominal pain should raise the suspicion of adnexal torsion. Inflammatory signs on CT suggest the presence of necrosis.	4
66. Duigenan S, Oliva E, Lee SI. Ovarian torsion: diagnostic features on CT and MRI with pathologic correlation. <i>AJR Am J Roentgenol.</i> 2012;198(2):W122-131.	Review/Other-Dx	N/A	CT and MRI features of ovarian torsion are illustrated with gross pathologic correlation.	Ovarian enlargement with or without an underlying mass is the finding most frequently associated with torsion, but it is nonspecific. A twisted pedicle, although not often detected on imaging, is pathognomonic when seen. Subacute ovarian hemorrhage and abnormal enhancement is usually seen, and both features show characteristic patterns on CT and MRI. Ipsilateral uterine deviation can also be seen.	4
67. Choi NJ, Rha SE, Jung SE, et al. Ruptured endometrial cysts as a rare cause of acute pelvic pain: can we differentiate them from ruptured corpus luteal cysts on CT scan? <i>J Comput Assist Tomogr.</i> 2011;35(4):454-458.	Observational-Dx	16 patients with surgically proven ruptured endometrial cyst and 19 patients with surgically proven corpus luteal cyst	To evaluate the usefulness of CT in the differentiation of ruptured endometrial cysts and corpus luteal cysts.	Ruptured endometrial cysts tend to show larger, multilocular cysts with a thicker wall compared to ruptured corpus luteal cysts ( $P<0.05$ ). A distorted shape of the cyst was more commonly seen in ruptured endometrial cyst, but direct CT findings that can suggest a rupture of an ovarian cyst, such as a discontinuity of the cyst wall and hemoperitoneum, were more commonly seen in ruptured corpus luteal cysts than in endometrial cysts ( $P<0.05$ ).	3
68. Birchard KR, Brown MA, Hyslop WB, Firat Z, Semelka RC. MRI of acute abdominal and pelvic pain in pregnant patients. <i>AJR Am J Roentgenol.</i> 2005;184(2):452-458.	Review/Other-Dx	29 pregnant patients; 6 complete abdominal US, 23 MRI	Prospective studies to show the usefulness of MRI in the evaluation of pregnant women with acute abdominal or pelvic pain.	Correlation of prospective clinical MRI interpretations with follow-up medical records showed correct identification of disease entities in all but 1 patient. In 1 patient, torsion of the ovary was neither described prospectively nor seen in retrospect. Intrinsic safety of MRI and its ability to accurately show abdominal and pelvic disease in pregnant patients make it highly useful in the evaluation of these patients.	4

**Acute Pelvic Pain in the Reproductive Age Group  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
69. Long SS, Long C, Lai H, Macura KJ. Imaging strategies for right lower quadrant pain in pregnancy. <i>AJR Am J Roentgenol.</i> 2011;196(1):4-12.	Review/Other-Dx	6 articles	To determine the best imaging technique to evaluate right lower quadrant pain in a pregnant patient.	MRI provides a valuable tool for the evaluation of pregnant patients with right lower quadrant pain and can help avoid unnecessary laparotomies and radiation exposure from CT. Because cases of the nonvisualized appendix on MRI pose a diagnostic difficulty, further studies are needed to improve imaging protocols to decrease the incidence of nonvisualized appendix.	4
70. Israel GM, Malguria N, McCarthy S, Copel J, Weinreb J. MRI vs. ultrasound for suspected appendicitis during pregnancy. <i>J Magn Reson Imaging.</i> 2008;28(2):428-433.	Observational-Dx	33 pregnant patients	To compare the sensitivity, specificity, PPV, and NPV of US and MRI in evaluation of pregnant patients with a clinical suspicion of appendicitis.	5 of the 33 patients had pathologically-proven appendicitis. 4 of the 5 patients with appendicitis were correctly diagnosed at MRI while 1 was interpreted as indeterminate (appendix not seen). At US, 1 was correctly diagnosed, 1 was incorrectly diagnosed as normal, and 3 were interpreted as indeterminate (appendix not seen). In 13 patients, a normal appendix was diagnosed at MRI, none of whom had appendicitis. In 3 patients, a normal appendix was diagnosed at US, 1 of whom had appendicitis. When the appendix was visualized at MRI, the sensitivity, specificity, PPV, and NPV for the diagnosis of appendicitis was 100% for all parameters. When the appendix was visualized at US, the sensitivity, specificity, PPV, and NPV for the diagnosis of appendicitis was 50%, 100%, 100%, and 66%, respectively.	3
71. Oto A, Ernst RD, Shah R, et al. Right-lower-quadrant pain and suspected appendicitis in pregnant women: evaluation with MR imaging--initial experience. <i>Radiology.</i> 2005;234(2):445-451.	Review/Other-Dx	23 pregnant women	Retrospective review to determine if there is a role for MRI in evaluation of pregnant women with acute right-lower-quadrant pain in whom acute appendicitis is suspected.	MRI shows promise for evaluation by enabling diagnosis of other possible causes of right-lower-quadrant pain.	4
72. Pedrosa I, Levine D, Eyvazzadeh AD, Siewert B, Ngo L, Rofsky NM. MR imaging evaluation of acute appendicitis in pregnancy. <i>Radiology.</i> 2006;238(3):891-899.	Observational-Dx	51 consecutive pregnant patients	To retrospectively assess the diagnostic performance of MRI in pregnant patients suspected of having acute appendicitis.	MRI is an excellent modality where sensitivity, specificity, prevalence-adjusted positive and NPV, and accuracy for MRI was 100%, 93.6%, 1.4%, 100%, and 94.0%, respectively.	3

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
73. Leeuwenburgh MM, Lameris W, van Randen A, Bossuyt PM, Boermeester MA, Stoker J. Optimizing imaging in suspected appendicitis (OPTIMAP-study): a multicenter diagnostic accuracy study of MRI in patients with suspected acute appendicitis. Study Protocol. <i>BMC Emerg Med.</i> 2010;10:19.	Review/Other-Dx	230 patients	To assess the diagnostic accuracy of MRI in unselected patients presenting with suspected acute appendicitis, and to estimate its costs, inter-observer agreement and patient acceptance. A study protocol is presented.	N/A	4
74. Fonseca AL, Schuster KM, Kaplan LJ, Maung AA, Lui FY, Davis KA. The use of magnetic resonance imaging in the diagnosis of suspected appendicitis in pregnancy: shortened length of stay without increase in hospital charges. <i>JAMA Surg.</i> 2014;149(7):687-693.	Observational-Dx	79 patients	To determine whether MRI in pregnant patients with suspected appendicitis improves outcomes, minimizes length of stay, and lowers hospital charges.	79 patients were included in this study, 34 of whom had pathology-confirmed appendicitis. 31 patients underwent MRI. A trend toward fewer operations (OR, 0.45; 95% CI, 0.18–1.16; $P=.07$ ) was observed in the MRI group. 7 nontherapeutic explorations were performed in the non-MRI group and 1 nontherapeutic exploration in the MRI group (OR, 0.44; 95% CI, 0.08–2.32; $P=.13$ ). Patients in the MRI group were more frequently discharged from the emergency department (OR, 0.35; 95% CI, 0.13–0.94; $P=.04$ ) and had shorter length of stay (33.7 vs 64.8 hours, $P<.001$ ). Gestational age, time to operation, and the presence of perforated appendicitis were similar between groups. No patient discharged without operation returned with appendicitis in either group. On multivariable analysis, the receipt of MRI ( $P<.001$ ) and the absence of operative intervention ( $P=.001$ ) were associated with shorter length of stay. The mean hospital charges were similar in those with vs without appendicitis. One fetal loss occurred in the non-MRI group.	3
75. Karul M, Berliner C, Keller S, Tsui TY, Yamamura J. Imaging of appendicitis in adults. <i>Rofo.</i> 2014;186(6):551-558.	Review/Other-Dx	N/A	To illustrate the principles of state-of-the-art imaging techniques and their clinical relevance.	US is the basic diagnostic method in case of suspected appendicitis. CT is necessary in patients with atypical presentation of appendicitis. MRI should be the first-line imaging test in pregnant women.	4

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
76. Pedrosa I, Lafornera M, Pandharipande PV, Goldsmith JD, Rofsky NM. Pregnant patients suspected of having acute appendicitis: effect of MR imaging on negative laparotomy rate and appendiceal perforation rate. <i>Radiology</i> . 2009;250(3):749-757.	Observational-Dx	148; Mean gestational age, 20 weeks	To investigate the effect of MRI on the negative laparotomy rate and the perforation rate in pregnant patients suspected of having acute appendicitis and to assess the need for CT in this setting.	MRI results were positive in all 14 (10%) patients with acute appendicitis. MRI results were negative in 125/134 patients without acute appendicitis; there were 9 false-positive cases (2 positive, 7 inconclusive). Among the patients without acute appendicitis, the normal appendix could be visualized on MRI in 87% (116/134) of cases ( $P<.0001$ ). 27 (18%) patients underwent surgical exploration, and 8 of them had negative laparotomy results, yielding a negative laparotomy rate of 30% and a perforation rate of 21% (3/14 patients). Only 4 (3%) patients underwent CT. For pregnant patients clinically suspected of having acute appendicitis, use of MRI yields favorable combinations of negative laparotomy rate and perforation rate compared with previously reported values. The radiation exposure associated with CT examination can be avoided in most cases.	3
77. Muthusami P, Bhuvanewari V, Elangovan S, Dorairajan LN, Ramesh A. The role of static magnetic resonance urography in the evaluation of obstructive uropathy. <i>Urology</i> . 2013;81(3):623-627.	Observational-Dx	69 patients	To assess the diagnostic accuracy of static MRU in hydronephrosis and to compare parameters of hydronephrosis in MRU with IV urography.	The sensitivity and specificity MRU in detecting hydronephrosis were 95% and 100%, respectively. In determining the level of obstruction, the strength of agreement between IV urography and MRU using kappa statistics was kappa = 0.66, which corresponds to a good level of agreement. The Spearman correlation coefficient for the grade of hydronephrosis on MRU and IV urography was 0.92 (95% CI, 0.86–0.95), with a $P<.0001$ . The correct diagnosis was made in 89.2% of the cases by IV urography and in 93.8% of the cases by MRU.	2
78. Roy C, Saussine C, LeBras Y, et al. Assessment of painful ureterohydronephrosis during pregnancy by MR urography. <i>Eur Radiol</i> . 1996;6(3):334-338.	Observational-Dx	17 pregnant women	To assess the rapid acquisition with relaxation enhancement MRU in pregnant women with painful ureterohydronephrosis.	Accuracy of MRU in the detection of urinary tract dilatation and the localization of the level of obstruction was excellent (sensitivity 100%).	1

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
79. Mullins JK, Semins MJ, Hyams ES, Bohlman ME, Matlaga BR. Half Fourier single-shot turbo spin-echo magnetic resonance urography for the evaluation of suspected renal colic in pregnancy. <i>Urology</i> . 2012;79(6):1252-1255.	Review/Other-Dx	9 pregnant women	To report the use of MRU in pregnant women suspected of having obstructing upper tract calculi.	The mean age of the subjects was 25 years (range 20–34); average gestational age of the fetus was 23 weeks (range 9–36). In all cases, a renal US was the initial imaging study obtained, with nondiagnostic findings. Half-Fourier acquisition single-shot turbo spin-echo MRU detected 4 ureteral stones and 4 cases of physiological hydronephrosis of pregnancy. In 1 case, interpretation of the MRU was limited as a result of patient motion. Of the patients with obstructing stones, 1 required endourologic management during her pregnancy and 3 were followed conservatively. No adverse events related to MRU occurred.	4
80. Spencer JA, Chahal R, Kelly A, Taylor K, Eardley I, Lloyd SN. Evaluation of painful hydronephrosis in pregnancy: magnetic resonance urographic patterns in physiological dilatation versus calculous obstruction. <i>J Urol</i> . 2004;171(1):256-260.	Review/Other-Dx	24 consecutive pregnant women	To evaluate MRU appearances in hydronephrosis in pregnancy and compare urographic patterns in physiological and calculous disease.	MRU is a valuable and well tolerated investigation for evaluating painful hydronephrosis in pregnancy.	4
81. De Santis M, Straface G, Cavaliere AF, Carducci B, Caruso A. Gadolinium periconceptional exposure: pregnancy and neonatal outcome. <i>Acta Obstet Gynecol Scand</i> . 2007;86(1):99-101.	Review/Other-Dx	26 pregnant women	Prospective cohort study to determine whether gadolinium derivatives exposure in periconceptional period is a risk factor for pregnancy or fetal development.	The authors report the outcome of 26 pregnant women exposed to gadolinium derivatives in the first trimester without adverse effect on pregnancy and neonatal outcome.	4
82. Torkzad MR, Bremme K, Hellgren M, et al. Magnetic resonance imaging and ultrasonography in diagnosis of pelvic vein thrombosis during pregnancy. <i>Thromb Res</i> . 2010;126(2):107-112.	Observational-Dx	27 patients	To evaluate the agreement between US and MRI in diagnosing the extent of DVT into the pelvic veins during pregnancy.	All 27 patients were imaged with both techniques at an average gestational age of 29 weeks (range 23–39). 3 cases (11.5%) of DVT in the pelvic veins were missed on US but detected by MRI. The upper limit of the DVT was always depicted at a higher (20 cases, 65.4%) or the same level (7 cases, 34.6%) on MRI than on US. Agreement expressed as kappa was 0.33 (95% CI, 0.27–0.40) demonstrating only fair agreement. In 1 woman the thrombus had propagated into the inferior vena cava, shown only on MRI.	3
83. Catalano C, Pavone P, Laghi A, et al. Role of MR venography in the evaluation of deep venous thrombosis. <i>Acta Radiol</i> . 1997;38(5):907-912.	Observational-Dx	43 patients	Comparative study to determine role of MRV in the evaluation of DVT.	MR can provide highly accurate images and is useful in the pelvic region.	2

**Acute Pelvic Pain in the Reproductive Age Group  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
84. Spritzer CE, Arata MA, Freed KS. Isolated pelvic deep venous thrombosis: relative frequency as detected with MR imaging. <i>Radiology</i> . 2001;219(2):521-525.	Review/Other-Dx	769 examinations 167 exams with DVT used in analysis	To determine the relative frequency of DVT isolated to the pelvic veins, as demonstrated with MRI.	DVT was identified in 167 (21.7%) of the 769 MRIs. 34 (20.4%) of the 167 studies demonstrated DVT isolated to the pelvic veins.	4
85. Ueda H, Togashi K, Kataoka ML, et al. Adnexal masses caused by pelvic inflammatory disease: MR appearance. <i>Magn Reson Med Sci</i> . 2002;1(4):207-215.	Review/Other-Dx	15 patients with 20 inflammatory adnexal masses	Retrospective analysis of images to describe the morphologic and signal intensity characteristics of inflammatory adnexal masses in MRI.	Pathological process of inflammation is well reflected on MR findings. Inflammatory adnexal masses are associated with specific appearances in MRI.	4
86. Li W, Zhang Y, Cui Y, Zhang P, Wu X. Pelvic inflammatory disease: evaluation of diagnostic accuracy with conventional MR with added diffusion-weighted imaging. <i>Abdom Imaging</i> . 2013;38(1):193-200.	Observational-Dx	187 patients	To determine the incremental value of MR diffusion-weighted imaging for the diagnosis of PIDs.	Laparoscopic and pathological findings confirmed the diagnosis in all patients. Conventional MR findings were consistent with a diagnosis of PID in 90.7% (117/129) and of non-PID in 93.3% (28/30) of the 159 patients. The sensitivity, specificity, PPV, NPV, and accuracy of conventional MRI findings vs the addition of diffusion-weighted imaging to conventional MR protocols for predicting PID were 90.7%, 93.3%, 98.3%, 70.0%, and 91.2% and 98.4%, 93.3%, 98.4%, 93.3%, and 97.5%, respectively.	2
87. Wilkinson C, Sanderson A. Adnexal torsion -- a multimodality imaging review. <i>Clin Radiol</i> . 2012;67(5):476-483.	Review/Other-Dx	N/A	To illustrate the wide variety of imaging features observed in adnexal torsion enabling a confident diagnosis that may result in a more favorable surgical outcome.	Although US is the initial imaging technique of choice in suspected adnexal torsion, many patients undergo CT or MRI either as a first-line test following nonspecific presentation, or as a confirmatory test following equivocal US findings.	4
88. American College of Radiology. ACR-SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation. Available at: <a href="http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Pregnant_Patients.pdf">http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Pregnant_Patients.pdf</a> . Accessed September 30, 2015.	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4

**Acute Pelvic Pain in the Reproductive Age Group**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
89. American College of Radiology. ACR-ACOG-AIUM-SRU Practice Parameter for the Performance of Obstetrical Ultrasound. Available at: <a href="http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/US_Obstetrical.pdf">http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/US_Obstetrical.pdf</a> . Accessed September 30, 2015.	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4
90. Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document on MR safe practices: 2013. <i>J Magn Reson Imaging</i> . 2013;37(3):501-530.	Review/Other-Dx	N/A	Guidance document on MR safety practices to help guide MR practitioners regarding MR safety issues and provide a basis for them to develop and implement their own MR policies and practices.	N/A	4
91. American College of Radiology. <i>Manual on Contrast Media</i> . Available at: <a href="http://www.acr.org/Quality-Safety/Resources/Contrast-Manual">http://www.acr.org/Quality-Safety/Resources/Contrast-Manual</a> . Accessed September 30, 2015.	Review/Other-Dx	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	4

## Evidence Table Key

### Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
  - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
  - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
  - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

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Dx = Diagnostic

Tx = Treatment

## Abbreviations Key

CI = Confidence interval

CT = Computed tomography

DVT = Deep venous thrombosis

hCG = Human chorionic gonadotropin

IUP = Intrauterine pregnancy

IV = Intravenous

LR = likelihood ratio

MDCT = Multidetector computed tomography

MRI = Magnetic resonance imaging

MRU = Magnetic resonance urography

MRV = Magnetic resonance venography

NPV = Negative predictive value

OR = Odds ratio

PID = Pelvic inflammatory disease

PPV = Positive predictive value

ROC = Receiver-operating characteristic

TOA = Tubo-ovarian abscess

TVU = Transvaginal ultrasound

US = Ultrasound