Ectopic Pregnancy Versus Corpus Luteum Cyst Revisited
Best Doppler Predictors

Mostafa Atri, MD, FRCPC

Objective. To determine the best Doppler values for differentiating ectopic pregnancy from a corpus luteum cyst of pregnancy. Methods. This was a prospective study of 80 consecutive patients with the diagnosis of ectopic pregnancy. All ectopic pregnancies were diagnosed on the basis of the presence of an extra-ovarian adnexal mass on sonography and were confirmed surgically. The last menstrual period ranged from 4 to 11 weeks (mean, 6.3 weeks), and the maximal ectopic pregnancy diameter ranged from 0.7 to 5.5 cm (mean, 2.5 cm). Seventy-six ectopic pregnancies showed color vascularity, and 40 showed corpus luteum cysts with vascular walls. The highest peak systolic velocity and the lowest resistive index of the vascular ectopic pregnancies were compared with the corresponding values in the vascular corpus luteum cysts. Results. The mean peak systolic velocity of the ectopic pregnancies was 35.4 cm/s compared with 28.4 cm/s in corpus luteum cysts, with no significant statistical difference (P = .1). The resistive index of the ectopic pregnancies ranged from 0.15 to 1.6 (mean ± SD, 0.61 ± 0.24) compared with 0.39 to 0.7 (mean, 0.52 ± 0.10) in corpus luteum cysts, with a significant statistical difference (P = .003). In this cohort, a resistive index of less than 0.39 had a specificity of 100% and a positive predictive value of 100% for diagnosing ectopic pregnancy but was present in only 15% (confidence interval, 7%–23%) of ectopic pregnancies. A resistive index of greater than 0.7 had a specificity of 100% and a positive predictive value of 100% for diagnosing ectopic pregnancy and was present in 31% (confidence interval, 21%–41%) of ectopic pregnancies. Conclusions. Both low and high resistive indices discriminate ectopic pregnancy from a corpus luteum cyst. Key words: corpus luteum cyst; ectopic pregnancy; peak systolic velocity; resistive index; sonography.

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Abbreviations
CLC, corpus luteum cyst; EP, ectopic pregnancy; hCG, human chorionic gonadotropin; PPV, positive predictive value; PSV, peak systolic velocity; RI, resistive index; TVS, transvaginal sonography

The advent of transvaginal sonography (TVS) has had a major impact in the evaluation of patients with ectopic pregnancy (EP).1-4 The main diagnostic feature of EP is the presence of an extra-ovarian tubal adnexal mass.3-5 Because the tubal mass is commonly related closely to the ovary, and the corpus luteum of pregnancy is located ipsilateral to EP in 80% of examinations, an exophytic corpus luteum cyst (CLC), being cystic or solid (involuting CLC), potentially can be mistaken for EP. The presence of a low resistive index (RI) in an adnexal mass has been proposed as an indicator for EP in the proper clinical setting.6,7 However, in our experience, EP can have a wide spectrum of RIs ranging from very low to very high.
The hypothesis of this study is that both low and high RIs could differentiate between EP and CLC. The purpose of this study was to evaluate whether high- as well as low-impedance flow could discriminate between EP and a CLC of the ovary and to determine the prevalence of discriminating impedance values.

Materials and Methods

This prospective study included a cohort of 80 consecutive patients with sonographically confirmed EPs at 1 institution that were confirmed at surgery. Serum β-human chorionic gonadotropin (β-hCG) findings were positive in all patients. The age range of the patients was 20 to 42 years (mean, 32 years). The last menstrual period ranged from 4 to 11 weeks (mean, 6.3 weeks). All patients underwent TVS with an empty bladder. The TVS examinations were performed with an Acuson 128XP system (Siemens Medical Solutions, Mountain View, CA) or a Toshiba 270 SLA system (Toshiba Medical Systems, Markham, Ontario, Canada) and a 5- or 7.5-MHz transducer. The lowest Doppler flow sensitivity on both machines was 3 cm/s. Suprapubic examination was performed only if the adnexal regions were not adequately seen on TVS.

The TVS criterion for a diagnosis of EP was the presence of a solid extra-ovarian adnexal mass with or without a cystic component.3–5 Although some series report low sensitivity for this criterion,8,9 in our practice, as in some other series,3–5 this sign has resulted in high sensitivity.

All the patients in this study had predominantly solid extra-ovarian adnexal masses on TVS. The lowest RIs and the highest angle-corrected peak systolic velocities (PSVs) were recorded in the EP and CLC of the ovary on the basis of a minimum of 3 measurements from the zones of high velocity with the use of color Doppler sonography as a road map. The angle of insonation was kept between 30° and 60°. Therefore, the Doppler indices were not measured if the extra-ovarian adnexal mass was avascular on the color Doppler examination. If there were more than 1 functional cyst in the ovary, the cyst with the highest vascularity was used to record the Doppler values.

For statistical analysis, continuous variables were calculated as mean ± SD. Comparisons between the 2 groups were made by the Student t test or the Mann-Whitney U test depending on the normalcy of the distribution of the values. P < .05 was considered significant. SPSS version 9.0 (SPSS Inc, Chicago, IL) was used for statistical analysis.

Results

Quantitative serum β-hCG levels were available in 70 patients. The serum β-hCG levels ranged from 22 to 48,048 IU/L (mean, 4451 IU/L; second International Standard). The maximal EP diameter varied from 0.7 to 5.5 cm (mean, 2.5 cm). Gestational sacs were present in 34 (42%) of 80 EPs, and live embryos were present in 5 (6%) of 80.

Corpus luteum cysts with mural color vascularity were identified in 40 (50%) of 80 patients. Color vascularity was present in 76 (95%) of 80 EPs. The ranges and means of the PSVs and RIs of the CLCs and EPs are shown in Table 1. There was no significant statistical difference between the PSVs in the CLCs and EPs (P = .1). However, there was a significant difference between the RIs of the CLCs and EPs (P = .003; Table 1). Figure 1 shows the distribution of RIs for EPs and CLCs. Table 2 shows the high and low RI thresholds with the highest specificity and positive predictive value (PPV) for differentiating EP from a CLC. An RI of less than 0.39 had a specificity and PPV of 100% for diagnosing EP but was seen in only 15% (sensitivity) of EPs. However, an RI of greater than 0.7 was present in 31% (sensitivity) of EPs with a specificity and PPV of 100%.

The mean serum β-hCG level in patients with EP RIs of less than 0.39 was 9429 IU/L, and in those with EP RIs of greater than 0.7, it was 2385 IU/L. The difference between the 2 groups was statistically significant (P = .006). The corresponding numbers for last menstrual period were 6.5 and 6.6 weeks, with no significant statistical difference between the 2 groups (P > .05).

<table>
<thead>
<tr>
<th>Entity</th>
<th>RI</th>
<th>PSV, cm/s</th>
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<tbody>
<tr>
<td>EP</td>
<td>0.15–1.6</td>
<td>3–80</td>
</tr>
<tr>
<td></td>
<td>(0.61 ± 0.24)</td>
<td>(35.4 ± 33)</td>
</tr>
<tr>
<td>CLC</td>
<td>0.39–0.7</td>
<td>7–81</td>
</tr>
<tr>
<td></td>
<td>(0.52 ± 0.10)</td>
<td>(28.4 ± 18)</td>
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</table>

Numbers in parentheses are mean ± SD.

Table 1. Values for RIs and PSVs in CLC and EP
Discussion

The presence of an extra-ovarian adnexal mass is the most common feature of EP. This feature has been shown to have a high specificity for diagnosing EP in a patient with a positive serum pregnancy test result. However, one of the most common pitfalls is mistaking an exophytic CLC of the ovary for EP in the adnexa. Pulsed Doppler examination of the adnexal mass has been suggested to help differentiate EP from a CLC of pregnancy because of the presence of a higher-velocity, lower-impedance flow in the EP. In a group of 73 EPs, Kurjak et al showed an RI of 0.36 ± 0.02 (SD) in EPs compared with 0.48 ± 0.04 in CLCs and suggested an RI of 0.4 to discriminate between EP and a CLC. However, other series have shown a higher mean RI in EP. In a group of 38 EPs reported by Tekay and Jouppila, the mean RI of EP was 0.51 ± 0.12. Moreover, Salim et al examined CLCs of pregnancy in 170 patients, which included both patients with EP and patients with intrauterine pregnancy, and they found a mean RI of 0.452 ± 0.04 in CLCs. Frates et al examined CLCs in 201 patients with intrauterine pregnancy between 5 and 8 weeks' gestation and found a mean RI of 0.50 ± 0.08. Therefore, there is overlap between the RIs of EPs and CLCs reported in different series, although, in general, EPs show lower RIs. To my knowledge, a higher RI has not been reported to be a discriminator of EP from a CLC of the ovary.

In this study's cohort, there was no significant difference in the PSV of EP versus a CLC. However, the RIs of EPs ranged from 0.15 to 1.6 (0.61 ± 0.24) compared with 0.39 to 0.7 (0.52 ± 0.10) for CLCs (P = .002). In this cohort, an RI of less than 0.39 had a specificity and PPV of 100% for diagnosing EP but was present in only 15% of EPs. Conversely, an RI of greater than 0.7 (Fig. 2) had a specificity and PPV of 100% for diagnosing EP and was present in 31% of EPs.

The higher RI in EP appears to be a predictor of spontaneous resolution of the EP. A higher RI in EP also correlates with a lower serum β-hCG level. That finding was confirmed in this series as well. The mean β-hCG level for EPs with RIs of less than 0.39 was 9429 IU/L, and in those with RIs of greater than 0.7, it was 2385 IU/L (P = .006). This suggests that EPs with higher RIs likely contain less active trophoblasts.

In conclusion, in this cohort, both extremes of RI discriminated EP from a CLC. An RI of greater than 0.7 for an adnexal mass in a patient with a positive serum β-hCG finding should help in differentiating EP from an exophytic CLC.

Table 2. Different RI Thresholds for Differentiating EP From CLC

<table>
<thead>
<tr>
<th>RI</th>
<th>Sensitivity, n (%)</th>
<th>Specificity, n (%)</th>
<th>PPV, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.39</td>
<td>12/80 (15)</td>
<td>40/40 (100)</td>
<td>12/12 (100)</td>
</tr>
<tr>
<td></td>
<td>(7–23)*</td>
<td></td>
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<tr>
<td>&gt;0.7</td>
<td>25/80 (31)</td>
<td>40/40 (100)</td>
<td>25/25 (100)</td>
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<tr>
<td></td>
<td>(21–41)*</td>
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</tbody>
</table>

*Confidence intervals.
References


