Transvaginal ultrasonography in the diagnosis of pelvic adhesions


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We studied the role of transvaginal ultrasonography and clinical factors in the diagnosis of pelvic adhesions in a population of 139 consecutive pre-menopausal non-pregnant women submitted to diagnostic and/or operative laparoscopy between February 1995 and November 1996. All patients underwent transvaginal ultrasonography and were interviewed within 2 days of their laparoscopy. The ultrasonographic impressions were then compared with the laparoscopic diagnosis. Patients were classified as having tuboperitoneal abnormalities if evidence of fimbrial, peritubal and/or peri-ovarian adhesions was encountered during surgery. The overall agreement between the ultrasound test result and the surgical findings was calculated using the $\kappa$ index. The adhesion of the ovary to the uterus, as evaluated by transvaginal ultrasonography, is most accurate in diagnosing pelvic adhesions ($\kappa = 0.5$) in comparison with the other ultrasonographic findings and clinical parameters. According to the logistic regression equation that was obtained, the probability of the presence of pelvic adhesions varied between a minimum of 12% for patients with no risk factors to a maximum of 93% for patients with three risk factors (previous pelvic surgery and transvaginal ultrasound findings of blurring of the margins of the ovary and adhesion of the ovary to the uterus).

Key words: infertility/pelvic adhesions/reproductive-age women/transvaginal ultrasound

Introduction

Tuboperitoneal abnormalities such as fimbrial, peritubal and peri-ovarian adhesions are a significant cause of infertility and pelvic pain (Yablonski et al., 1990; Wolner-Hanssen, 1995) and are related to the presence of intraluminal tubal disease (Bowman and Cooke, 1994). Furthermore, pelvic adhesions may impair the reproductive prognosis (Yablonski et al., 1990), interfering with the results of assisted reproductive technologies (al-Shawaf et al., 1990; Fakih and Marshall, 1994; Csemiczky et al., 1996) and with ovarian function (Bowman et al., 1993). Laparoscopy is the gold standard in the diagnosis of this disease, but less invasive techniques should be proposed to allow appropriate patient counselling of further diagnostic or therapeutic interventions and to reduce the number of unnecessary laparoscopies. Although using transvaginal ultrasonography without contrast medium is not suitable for the evaluation of tubal patency (Guerriero et al., 1996), this non-invasive, diagnostic tool provides high soft tissue contrast resolution that could also investigate the presence of some tuboperitoneal abnormalities. Several studies have investigated the ultrasonographic appearance of hydrosalpinx and sactosalpinx (thin wall, sometimes with nodular thickening, the fluid in the tube is relatively echogenic; Timor-Tritsch and Rottem, 1987; Cacciatore et al., 1992; Kupesic et al., 1995). Few retrospective studies have attempted to relate ultrasonographic findings to the presence of pelvic adhesions. However, these have included patients with acute symptoms (Patten et al., 1990; Cacciatore et al., 1992) or ectopic pregnancies (Lande et al., 1988).

The aim of this prospective study was to investigate the accuracy of clinical factors and transvaginal ultrasonography in the evaluation of pelvic adhesions in women undergoing diagnostic and/or operative laparoscopy for gynaecological disease. The $\kappa$ index was calculated and used to evaluate the extent of agreement between test results and findings on surgery (Fleiss, 1981).

Materials and methods

Subjects

This study was approved by the ethical committee of the Department of Obstetrics and Gynaecology of the University of Cagliari, Italy. A total of 139 consecutive pre-menopausal non-pregnant women who were admitted for surgery between February 1995 and November 1996 were included in the study. The mean ± SD age of the study population was 32.3 ± 6.9 years (range 17–53). All patients were referred to the Department of Obstetrics and Gynaecology and underwent diagnostic and/or operative laparoscopy for infertility ($n = 46$), pelvic pain ($n = 48$), uterine fibroids <40 mm ($n = 13$), endometrial hyperplasia ($n = 5$) or persistent adnexal masses <45 mm ($n = 27$). Women with evidence of acute genital inflammation, previous bilateral salpingo-oophorectomy, previously treated ovarian carcinoma, fibroids >40 mm, ovarian masses >45 mm or endometrial or cervical carcinomas were excluded from the study.

Methods

At interview, ‘clinical factors’ were elicited, including a history of pelvic pain or infection, previous pelvic surgery, including tubal surgery and appendectomy, and the use of an intrauterine device (Stovall et al., 1989). All patients underwent transvaginal ultrasonography performed, within 2 days of surgery, using an Acuson scanner XP/10 OB (Acuson Inc., Mountain View, CA, USA) with a 7 MHz
Figure 1. The B-mode findings related to the presence of pelvic adhesions: fixation of the ovary (O) to the uterus (U) (left panel), blurring of the margins of the ovary associated with augmentation of the usual distance of the ovary (between the marking callipers) from the sonographic probe (right panel).

Table I. Accuracy of different ultrasonographic findings in the diagnosis of pelvic adhesions

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive predictive value</th>
<th>Negative predictive value</th>
<th>(\kappa) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixation</td>
<td>43/67 (64)</td>
<td>62/72 (86)</td>
<td>43/53 (81)</td>
<td>62/86 (72)</td>
<td>0.51</td>
</tr>
<tr>
<td>Distance</td>
<td>31/67 (46)(^a)</td>
<td>61/72 (85)(^b)</td>
<td>31/42 (74)</td>
<td>61/97 (63)</td>
<td>0.31</td>
</tr>
<tr>
<td>Margins</td>
<td>51/67 (76)(^b)</td>
<td>45/72 (63)(^a)</td>
<td>51/78 (65)</td>
<td>45/61 (74)</td>
<td>0.38</td>
</tr>
<tr>
<td>At least one positive test</td>
<td>62/67 (93)(^a)</td>
<td>38/72 (53)(^a)</td>
<td>62/96 (65)</td>
<td>38/43 (88)</td>
<td>0.45</td>
</tr>
<tr>
<td>Three positive tests</td>
<td>20/67 (30)(^a)</td>
<td>68/72 (94)(^b)</td>
<td>20/24 (83)</td>
<td>68/115 (59)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Values in parentheses are percentages.

\(^a\)Significantly different from fixation used alone; \(P < 0.05\).

\(^b\)Not significantly different from fixation used alone.

Statistics

The sensitivity, specificity and positive and negative predictive values were calculated for transvaginal ultrasonographic findings, clinical factors and a combination of clinical factors and ultrasonographic findings. The \(z\) statistic for the comparison of two proportions (Glantz, 1981) was used to evaluate the results. To evaluate the overall agreement between a test result and the presence or absence of pelvic adhesions, the \(\kappa\) index was calculated according to Fleiss (1981). \(\kappa\) values ranging between 0.40 and 0.75 were assumed to indicate a strong agreement. The influence of different sonographic findings and clinical parameters was studied by stepwise logistic regression using the Statistical Package for the Social Sciences for Macintosh, version 6.1.1 (SPSS Inc., Chicago, IL, USA). The model of best fit that adequately described the data was chosen (Tomlinson et al., 1996).

Results

Both ovaries were visualized in all patients. In all, 67 (48%) of the patients were found to have tuboperitoneal abnormalities at laparoscopy.

The sensitivity, specificity, positive and negative predictive values and \(\kappa\) index of different transvaginal ultrasonographic findings in the diagnosis of pelvic adhesions are shown in Table I. The adhesion of the ovary to the uterus is the ultrasonographic finding that best correlates with the presence of pelvic adhesions.

transvaginal probe. All scans were performed by one of the authors (S.G.), who was blinded to the patient’s history. The presence of one of the following findings was considered to indicate the likelihood of pelvic adhesions: (i) blurring of the margins of the ovary (margins), defined as the absence of the exact contour of the ovary in more than three-quarters of the ovary (as for ‘fixation’ and ‘distance’, ‘margins’ has been considered pathological only when it remained unchanged after the end of abdominal palpation); (ii) adhesion from the ovary to the uterus, which persisted with abdominal palpation (fixation); (iii) augmentation of the usual distance of the ovary from the probe which persisted with abdominal palpation (distance) (Figure 1; Lande et al., 1988; Patten et al., 1990; Böhm-Velez and Mendelson, 1993). The augmentation of the usual distance of the ovary from the probe was calculated in a preliminary study performed in 20 patients who at laparoscopy had no adhesions. The mean \(\pm\) SD distance was 7.1 \(\pm\) 1.9 mm (range 3–11). The maximum distance from the probe (11 mm) was used as a cut-off value. The exact mean \(\pm\) SD values of the distance of the ovary from the probe in the studied subjects were 12.8 \(\pm\) 5.3 mm in patients with pelvic adhesions and 8.1 \(\pm\) 4.0 mm in patients without pelvic adhesions.

Patients were classified as having tuboperitoneal abnormalities if evidence of fimbrial, peritubal and/or peri-ovarian adhesions was encountered during surgery (Yablonski et al., 1990; Dabekausen et al., 1994; Fakih and Marshall, 1994; Meikle et al., 1994). The ultrasonographic impressions and the clinical details were then compared with the laparoscopic findings.
Adhesions and transvaginal ultrasonography

Table II. Accuracy of different clinical factors in the diagnosis of pelvic adhesions

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive predictive value</th>
<th>Negative predictive value</th>
<th>( \kappa ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of pelvic pain</td>
<td>40/67 (60)</td>
<td>37/72 (51)</td>
<td>40/75 (53)</td>
<td>37/64 (58)</td>
<td>0.11</td>
</tr>
<tr>
<td>Previous pelvic surgery</td>
<td>36/67 (54)</td>
<td>57/72 (79)</td>
<td>36/51 (71)</td>
<td>57/88 (65)</td>
<td>0.33</td>
</tr>
<tr>
<td>History positive(^a)</td>
<td>38/67 (57)</td>
<td>50/72 (69)</td>
<td>38/60 (63)</td>
<td>50/79 (63)</td>
<td>0.26</td>
</tr>
<tr>
<td>Appendectomy</td>
<td>3/167 (18)</td>
<td>46/72 (64)</td>
<td>31/57 (63)</td>
<td>46/82 (63)</td>
<td>0.10</td>
</tr>
</tbody>
</table>

\(^a\)For any of the following: pelvic infection, intrauterine device, ovarian or tubal surgery.

Values in parentheses are percentages.

Table III. Comparison of combined methods in the diagnosis of pelvic adhesions

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive predictive value</th>
<th>Negative predictive value</th>
<th>( \kappa ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance and fixation(^a)</td>
<td>26/67 (39)</td>
<td>61/72 (85)</td>
<td>26/37 (70)</td>
<td>61/102 (60)</td>
<td>0.24</td>
</tr>
<tr>
<td>Distance and/or fixation(^d)</td>
<td>48/67 (72)</td>
<td>55/72 (76)</td>
<td>48/65 (74)</td>
<td>55/74 (74)</td>
<td>0.48</td>
</tr>
<tr>
<td>Margins and fixation(^a)</td>
<td>33/67 (49)</td>
<td>66/72 (92)</td>
<td>33/39 (85)</td>
<td>66/100 (66)</td>
<td>0.42</td>
</tr>
<tr>
<td>Margins and/or fixation(^d)</td>
<td>59/67 (88)</td>
<td>41/72 (57)</td>
<td>59/90 (66)</td>
<td>41/49 (84)</td>
<td>0.44</td>
</tr>
<tr>
<td>Previous pelvic surgery and fixation(^a)</td>
<td>23/67 (34)</td>
<td>68/72 (94)</td>
<td>23/27 (85)</td>
<td>68/112 (61)</td>
<td>0.29</td>
</tr>
<tr>
<td>Previous pelvic surgery and/or fixation(^d)</td>
<td>56/67 (84)</td>
<td>51/72 (71)</td>
<td>56/77 (73)</td>
<td>51/62 (82)</td>
<td>0.54</td>
</tr>
<tr>
<td>Previous pelvic surgery and at least one ultrasonographic finding(^a)</td>
<td>32/67 (48)</td>
<td>61/72 (85)</td>
<td>32/43 (74)</td>
<td>61/96 (64)</td>
<td>0.33</td>
</tr>
<tr>
<td>Previous pelvic surgery and/or at least one ultrasonographic finding(^d)</td>
<td>66/67 (99)</td>
<td>34/72 (47)</td>
<td>66/104 (63)</td>
<td>34/35 (97)</td>
<td>0.45</td>
</tr>
</tbody>
</table>

\(^a\)Both tests positive.
\(^d\)Significantly different from fixation used alone; \( P < 0.05 \).
\(^\text{not significantly different from fixation used alone.}\)
\(^\text{Either test positive.}\)

Values in parentheses are percentages.

The sensitivity, specificity, positive and negative predictive values and \( \kappa \) index of different clinical factors in the diagnosis of pelvic adhesions are displayed in Table II. No factors reported a \( \kappa \) index >0.4.

The presence of a history of previous pelvic surgery, when combined with the ultrasonographic findings of fixation of the ovary to the uterus, showed a higher value of \( \kappa \) than if the ultrasound findings alone were used. However, the specificity was reduced significantly (\( P < 0.05 \); Table III).

A logistic regression analysis was performed to identify prognostic factors in the detection of adhesions. Each parameter was entered sequentially into the model. The best fit model was obtained and is displayed in Table IV. The significant variables were: previous pelvic surgery (\( P < 0.01 \)) and, by transvaginal ultrasonography, blurring of the margins of the ovary (\( P < 0.01 \)) and adhesion of the ovary to the uterus (\( P < 0.00001 \); Table IV). The equation that describes the probability of the presence of pelvic adhesions according to the significant variables is as follows: \( P = 1/(1 + \exp[-1.97134 + 2.103965 \times (\text{adhesion of the ovary to the uterus}) + 1.223936 \times (\text{blurring of the margins of the ovary}) + 1.168429 \times (\text{previous pelvic surgery})]) \). According to this formula, the probability of the presence of pelvic adhesions varied between a minimum of 12% for patients with no risk factors to a maximum of 93% for patients with three risk factors.

Discussion
This study suggests an important role for transvaginal ultrasonography in the evaluation of pelvic adhesions in non-
pregnant women without evidence of acute genital inflammation. It must be considered that the good predictive capacity of transvaginal ultrasonography demonstrated in our group study may not be true in the general asymptomatic population. However, in symptomatic patients transvaginal ultrasonographic evaluations may be useful to indicate the need for further diagnostic or therapeutic interventions. This evaluation should be performed in the follicular phase of the menstrual cycle to reduce the risk of ovarian and uterine size changes, which occur in the luteal phase.

Other techniques have been used to evaluate the presence of peritubal adhesions but with controversial results (Dabekausen et al., 1994; Meikle et al., 1994; Swart et al., 1995). From the results reported in the meta-analysis performed by Swart et al. (1995), the hysterosalpingography (HSG) seems unreliable for the diagnosis of peritubal adhesions. A recent study from the same group (Mol et al., 1996) confirmed that HSG has no value in the detection of peritubal adhesions because it shows low reproducibility. However, promising results have been obtained by using *Chlamydia trachomatis* antibody (Dabekausen et al., 1994; Meikle et al., 1994) or transvaginal colour Doppler (Kupesic et al., 1995). These methods could be used in addition to B-mode transvaginal ultrasonography in the preliminary evaluation of the infertile couple. Transvaginal ultrasonography is also useful in monitoring ovarian follicle growth, ovulation and corpus luteum formation, and in evaluating the normal anatomy of the uterus and cervix, and their cyclical responses to ovarian steroids (Blumenfeld et al., 1990). As a result of this study, pelvic adhesions can also be suspected with sufficient accuracy. The use of simple ultrasonographic findings, e.g. adhesion of the ovary to the uterus and distance from the probe, should increase the reproducibility of transvaginal ultrasound evaluations. In our opinion, more attention should be paid to the evaluation of blurring of the ovarian margin. On the other hand, a skilled sonographer must evaluate with accuracy the presence of the normal contour of the ovary. Evaluation of tubal patency is the next step in these patients. Transvaginal hysterosalpingo-contrast sonography with an echo contrast agent is a useful test for the detection of tubal patency but not for the detection of other tubal infertility-related abnormalities such as peritubal adhesions (Guerriero et al., 1996).

This study has demonstrated that abnormal results from transvaginal ultrasound examinations accurately identify patients with pelvic adhesions. Adhesion of the ovary to the uterus is a reliable finding with a positive predictive value of 81%. Therapeutic considerations in this clinical situation include laparoscopy for adhesiolyis or in-vitro fertilization (IVF). We prefer to perform a laparoscopy to confirm the diagnosis and to remove the adhesions that may impair the results of subsequent assisted reproduction procedures (al-Shawaf et al., 1990; Fakhri and Marshall, 1994; Csemiczky et al., 1996). Otherwise, adhesiolyis is an effective treatment of infertility and is associated with a good pregnancy rate similar to that reported after five cycles of IVF (Oelsner et al., 1994). The same surgical procedure is effective in the resolution of chronic pelvic pain (Saravelos et al., 1995). As derived by logistic regression, the absence of ultrasonographic and clinical factors reduces the possibility of the presence of pelvic adhesions to 12%. If tubal patency is present, these patients can postpone diagnostic laparoscopy for three to six cycles of intrauterine insemination (Melis et al., 1995) with a low risk of the undiagnosed presence of pelvic adhesions.

In conclusion, less invasive techniques, such as transvaginal ultrasonography, when associated with the evaluation of clinical factors may be reliably used in the assessment of symptomatic patients. This will hopefully reduce the number of unnecessary laparoscopies.

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**References**


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