Ultrasound Obstet Gynecol 2014; **44**: 710–718
Published online in Wiley Online Library (wileyonlinelibrary.com). **DOI:** 10.1002/uog.13422

Office gel sonovaginography for the prediction of posterior deep infiltrating endometriosis: a multicenter prospective observational study

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KEYWORDS: DIE; laparoscopy; office gel sonovaginography; posterior deep infiltrating endometriosis; sliding sign; SVG

ABSTRACT

Objective *To use office gel sonovaginography (SVG) to predict posterior deep infiltrating endometriosis (DIE) in women undergoing laparoscopy.*

Methods *This was a multicenter prospective observational study carried out between January 2009 and February 2013. All women were of reproductive age, had a history of chronic pelvic pain and underwent office gel SVG assessment for the prediction of posterior compartment DIE prior to laparoscopic endometriosis surgery. Gel SVG findings were compared with laparoscopic findings to determine the diagnostic accuracy of office gel SVG for the prediction of posterior compartment DIE.*

Results *In total, 189 women underwent preoperative gel SVG and laparoscopy for endometriosis. At laparoscopy, 57 (30%) women had posterior DIE and 43 (23%) had rectosigmoid/anterior rectal DIE. For the prediction of rectosigmoid/anterior rectal (i.e. bowel) DIE, gel SVG had an accuracy of 92%, sensitivity of 88%, specificity of 93%, positive predictive value (PPV) of 79%, negative predictive value (NPV) of 97%, positive likelihood ratio (LR+) of 12.9 and negative likelihood ratio (LR−) of 0.12 (*$P = 3.98E{-}25$*); for posterior vaginal wall and rectovaginal septum (RVS) DIE, respectively, the accuracy was 95% and 95%, sensitivity was 18% and 18%, specificity was 99% and 100%, PPV was 67% and 100%, NPV was 95% and 95%, LR+ was 32.4 and infinity and LR− was 0.82 and 0.82 (*$P = 0.009$ *and* $P = 0.003$*).*

Conclusions *Office gel SVG appears to be an effective outpatient imaging technique for the prediction of bowel DIE, with a higher accuracy for the prediction of rectosigmoid compared with anterior rectal DIE. Although the sensitivity for vaginal and RVS DIE was limited, gel SVG had a high specificity and NPV for all forms of posterior DIE, indicating that a negative gel SVG examination is highly suggestive of the absence of DIE at laparoscopy.* Copyright © 2014 ISUOG. Published by John Wiley & Sons Ltd.

INTRODUCTION

Most ultrasound centers do not assess for deep infiltrating endometriosis (DIE) in women undergoing standard pelvic ultrasound examination due to chronic pelvic pain. Given that more than 80% of women with chronic pelvic pain will have endometriosis at surgery[1] and that between 3.8 and 37% of women with endometriosis will have bowel DIE[2], there is a need to conduct a thorough assessment of the posterior pelvic compartment for DIE in women presenting with chronic pelvic pain or other symptoms suggestive of endometriosis.

Posterior compartment DIE has been visualized with various imaging techniques, including: transvaginal ultrasound (TVS)[3–12], TVS with water contrast in the rectum[10,13,14], TVS with double-contrast barium enema[15], saline sonovaginography (SVG)[16–18], transrectal ultrasound[10,12], sonorectovaginography[19], computed tomography (CT)[20,21], magnetic resonance imaging[17,22–24] and three-dimensional introital TVS[25].

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Accepted: 29 April 2014

Among these, TVS has been suggested as the first-line imaging technique, as it is well-tolerated by patients, has a diagnostic accuracy comparable to that of other imaging techniques and is less costly[5]. However, the ability to identify accurately posterior compartment DIE with TVS can be difficult, and requires specialized training and experience. In the hands of 'experienced operators', TVS has been reported to have a sensitivity ranging from 78.5 to 87.3% and a positive predictive value (PPV) of 95.4 to 98.6%, for the prediction of all posterior compartment DIE (bowel (anterior rectum and rectosigmoid), rectovaginal septum (RVS), vagina and uterosacral ligaments (USL))[5,11]. The sensitivity for TVS in the prediction of vaginal and RVS DIE alone, however, is much lower, as these lesions are apparently more difficult to visualize[5,26,27].

Previous studies have used an adapted TVS technique, 'saline SVG', developed in an attempt to improve the preoperative diagnosis of vaginal and RVS DIE, in which normal saline is placed into the posterior vaginal fornix to create an acoustic window, allowing improved visualization of the structures of the posterior pelvic compartment[16,17]. The aim of our study was to evaluate the use of a newly modified SVG technique, outpatient 'office gel SVG'[28–30], for the prediction of posterior compartment DIE.

SUBJECTS AND METHODS

This was a multicenter prospective observational study performed from January 2009 to February 2013. We enrolled consecutively into the study 220 women who presented to the pelvic pain clinic with symptoms suggestive of endometriosis (i.e. chronic pelvic pain[29], dysmenorrhea, dyspareunia and/or dyschezia) and were scheduled to undergo laparoscopy. Women were considered eligible for inclusion if they were of reproductive age and had a history of chronic pelvic pain with or without a history of endometriosis. Exclusion criteria were: malignancy; premenarche; menopause; and pregnancy. An information sheet was given to eligible women and informed consent was obtained. Women who underwent gel SVG but did not undergo laparoscopy within the following 6 months were excluded from the final analysis. Ethics approval for the study was obtained from the Human Research Ethics Committee, Sydney West Area Health Service, Nepean Campus, Penrith, Australia. Data from the first 100 patients in this study have been analyzed and previously published in a TVS study investigating the association between the 'sliding sign' and pouch of Douglas (POD) obliteration[29].

Office gel SVG examinations were performed at two different sites: Nepean Hospital and OMNI Gynaecological Care. Laparoscopy was performed at one of nine different hospitals: Nepean, Norwest Private, Royal Hospital for Women, Royal Prince Alfred, Hurstville Private, St Luke's Private, Prince of Wales Private, Liverpool and St George Private Hospitals.

Following a standardized protocol, relevant history was noted for all women, and all underwent clinical (including vaginal) examination and preoperative TVS, followed immediately by gel SVG, in a gynecological outpatient setting. A single examiner (S.R. or G.C.) performed the clinical and ultrasound examination for each woman. LOGIQ-e -I (GE Medical Systems, Zipf, Austria) or Medison X8, V20 or XG (Samsung Medison, Seoul, South Korea) ultrasound machines, equipped with a 7.5-MHz transvaginal probe, were used to perform the ultrasound examinations. One examiner (G.C.) was an expert gynecological sonologist with experience in the diagnosis of DIE, while the other (S.R.) was a gynecological ultrasound fellow, and was supervised by G.C. for all TVS and gel SVG examinations.

During TVS, the ovaries and uterus were assessed for mobility and pathology, and the POD was assessed for obliteration using the sliding sign[29].

In order to perform the gel SVG examination, before insertion of the transvaginal probe, 20 mL ultrasound gel was inserted into the posterior vaginal fornix using a 20-mL plastic syringe. The gel created an acoustic window, allowing a 'stand-off' view of the structures of the posterior compartment. The gel was loaded carefully into the syringe, ensuring there were minimal air bubbles/pockets within the gel. The syringe was filled completely, so that the plunger came in direct contact with the gel, thus further reducing the possibility of air pockets when instilling the gel into the vagina. We took care to ensure that the syringe was inserted far enough into the vaginal canal such that the gel filled the posterior fornix completely; no woman required any refilling of the posterior fornix with gel.

At gel SVG the structures of the posterior compartment (posterior vaginal wall, posterior uterus/cervix, RVS, anterior rectum, rectosigmoid and USL) were assessed for DIE in both mid-sagittal and transverse planes. First, the examiner identified the lower end of the rectum (just superior to the anal verge) by visualizing the linear hypoechoic longitudinal muscle (muscularis propria) of the anterior rectum. The probe was then advanced along the posterior vaginal wall towards the posterior vaginal fornix. The posterior vaginal wall had slightly increased echogenicity compared with the cervical region, whereas the RVS appeared as a bright hyperechoic layer, located between the lower two-thirds of the posterior vaginal wall and the longitudinal muscle of the anterior rectum (muscularis propria) (Figure 1). The hyperechoic RVS layer was traced anteriorly, from the lower vagina/rectum to the level of its termination (i.e. at the peritoneal reflection of the POD). The sonologist traced the anterior rectum to 14 cm above the anal verge and then the rectosigmoid bowel to the highest possible level (i.e. to the level of the uterine fundus some 25–30 cm above the anal verge). In order to keep the anterior rectal/rectosigmoid wall in view in the sagittal plane, the operator was required to rotate the transvaginal probe in the horizontal plane (0–180°) and elevate/lower the probe as needed.

RVS DIE was predicted when the hyperechoic RVS layer was interrupted or no longer visible due to the presence of a DIE lesion. Rectal/rectosigmoid DIE was predicted when

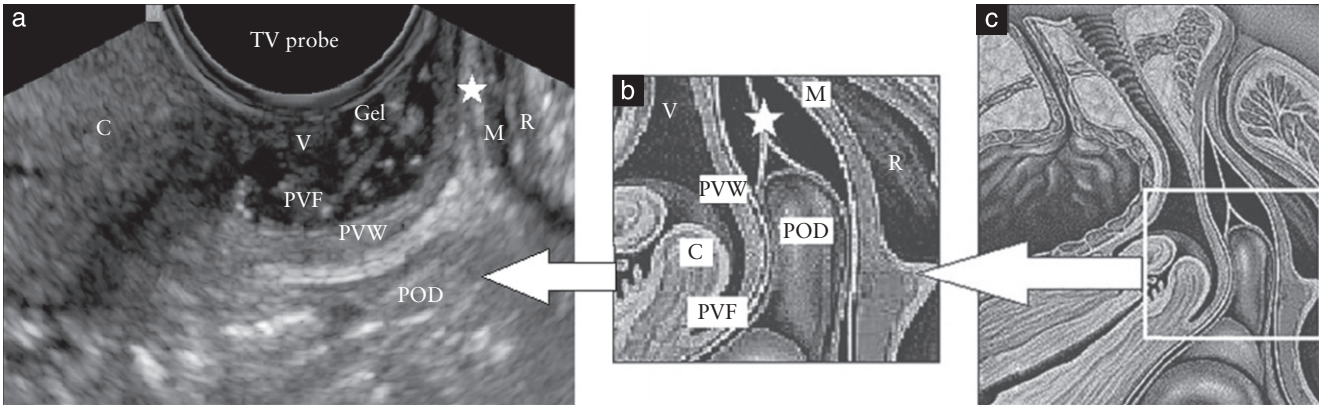

Figure 1 (a) Visualization of a normal posterior compartment using gel sonovaginography (sagittal plane). (b,c) Schematic representations of corresponding structures in the posterior pelvic compartment (sagittal plane) (reprinted from Cruikshank and Kovac[33], with permission from Elsevier). ⋆, rectovaginal septum; C, cervix; M, muscularis propria of the anterior rectum; POD, pouch of Douglas; PVF, posterior vaginal fornix; PVW, posterior vaginal wall; R, anterior rectum; TV, transvaginal; V, vagina.

the normally linear hypoechoic longitudinal muscle was thickened by a hypoechoic mass, which could be visualized in both the sagittal and transverse planes during gel SVG. Each suspected DIE bowel lesion was reviewed carefully during the examination to confirm that the mass was a solid structure and was continuous within the longitudinal muscle of the bowel. Videoclip S1 demonstrates the use of gel SVG to visualize an anterior rectal wall nodule. All bowel DIE lesions were observed to at least infiltrate the muscularis layer; this study did not evaluate specifically the accuracy of gel SVG regarding the depth of invasion of bowel DIE. Figure 2 displays the various forms of anterior rectal/rectosigmoid DIE visualized during gel SVG. As in the TVS examination, during gel SVG we used the sliding sign to determine whether adhesions existed between the anterior rectum/rectosigmoid and the posterior vaginal wall/cervix/uterus (i.e. POD obliteration) (Videoclips S2a–c). Figure 3 displays the use of office gel SVG to visualize a normal posterior vaginal wall compared with a vaginal wall with a DIE nodule, which was visualized as a protrusion from the normally smooth-contoured posterior vaginal wall. The USL were not identifiable with gel SVG in the absence of fluid in the POD or in the absence of a USL DIE lesion. USL nodules were identified as defined hypoechoic lesions located laterally alongside the cervix. Depending on the number and complexity of the DIE lesions visualized in the posterior compartment, the time required to perform the gel SVG examination ranged between 30 and 45 min. Subjectively, the examination was well-tolerated by all women.

Surgical findings were verified through review (by S.R.) of the surgeons' detailed operation reports and diagrams made at the time of surgery. Surgery was performed by one of thirteen laparoscopic surgeons: nine advanced gynecological laparoscopic surgeons, all of whom were experienced in the excision of complex pelvic disease, performed the procedure in women with preoperative SVG/TVS findings indicating the presence of posterior compartment DIE and/or POD obliteration, and four general gynecological surgeons performed the procedure in the remaining women. The operative techniques were similar amongst all surgeons involved in the study and surgeons were not blinded to the patient's symptoms or to gel SVG findings prior to laparoscopy. All women with suspected bowel endometriosis underwent preoperative colorectal counseling regarding the possible risks and need for bowel surgery. Thorough inspection of the abdomen and pelvis was performed to identify any pathology, such as: ovarian cysts, ovarian fixation/adhesions, POD obliteration and/or DIE lesions.

The gold standard surgical diagnosis of endometriosis was made if any of the following criteria was satisfied: (1) histological confirmation of endometriosis in at least one resected subperitoneal nodule; (2) visualization and palpation of a subperitoneal nodule without biopsy and another histologically proven location of endometriosis; (3) visualization of complete obliteration of POD[5]. Of the 47 women with POD obliteration, 44 (94%) underwent complete surgical dissection of the POD. Complete surgical excision of posterior compartment DIE was performed in 52 of 57 (91%) women. The five women who did not undergo excision of posterior DIE were all reported to have anterior rectal DIE (diagnosed at laparoscopy). Two of these five women did not have an obliterated POD, and the bowel nodule was diagnosed through direct visualization and palpation of a firm rectal nodule. For the other three women with POD obliteration and a rectal nodule, the rectum was tethered to the posterior cervix/uterus and the nodule was palpable within the underlying rectal wall.

Statistical analysis

Univariate analysis of the data was used to investigate the distribution of variables in women included in this study. Descriptive statistics for the continuous variables are presented using the mean and SD, with *P*-values calculated using ANOVA tests; binary variables are presented as number and frequency (%), with *P*-values calculated using Fisher's exact test. $P < 0.05$ was considered statistically significant. Data were analyzed to determine the accuracy, sensitivity, specificity, PPV, negative predictive value

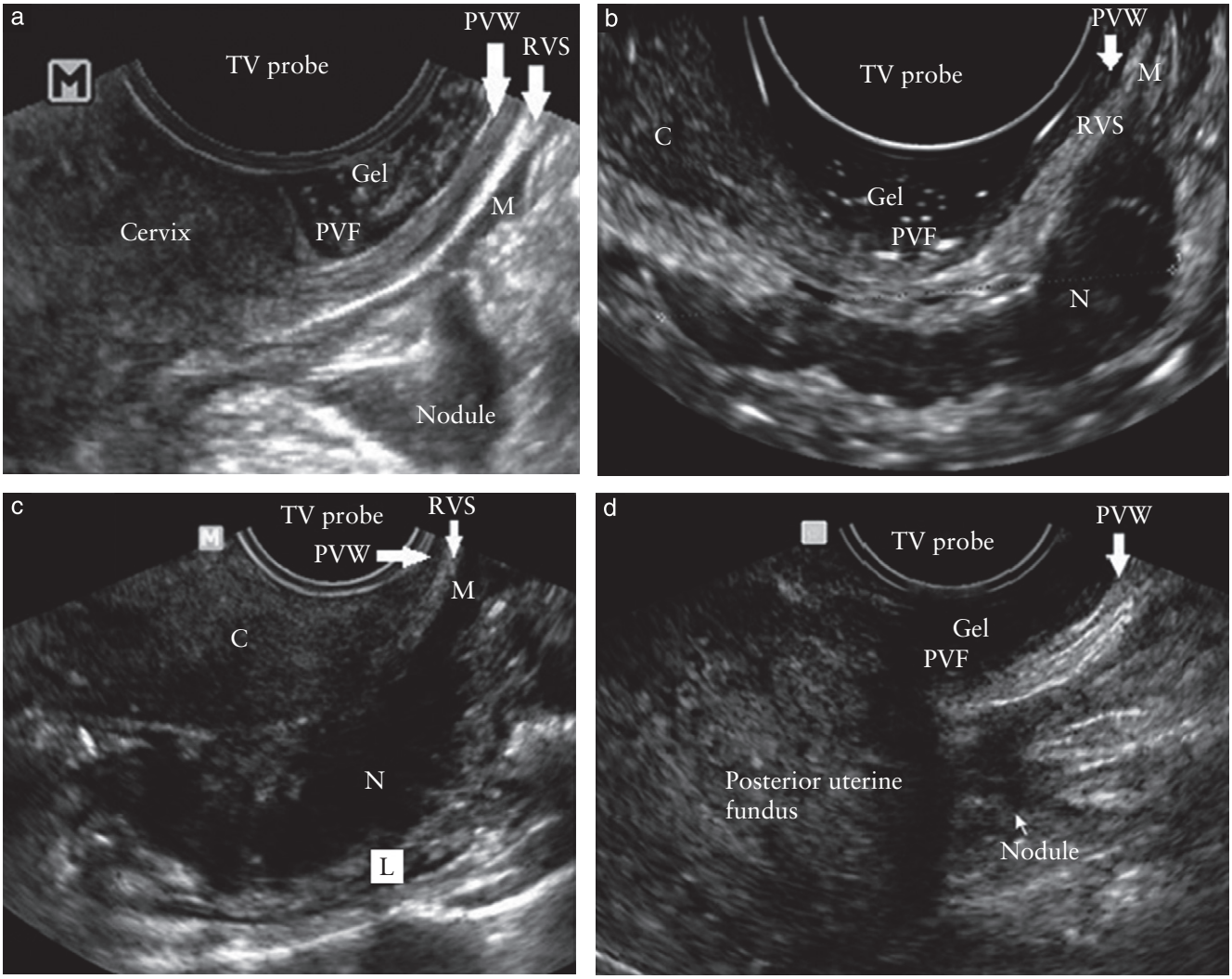

Figure 2 Appearance of rectal deep infiltrating endometriosis (DIE) on gel sonovaginography (sagittal plane). (a) Crescent-shaped hypoechoic anterior rectal nodule infiltrating the muscularis propria of the anterior rectum. (b) Elongated hypoechoic anterior rectal nodule infiltrating the muscularis propria of the anterior rectum. (c) Anterior rectal/rectosigmoid DIE lesion which appears hypoechoic and plaque-like, with infiltration into the posterior cervix, rectovaginal septum (RVS) and submucosal layer of the anterior rectum (as identified by loss of the hypoechoic submucosal layer). (d) Rectosigmoid nodule adherent to the posterior fundus, causing an anteverted, retroflexed uterus. C, cervix; L, lumen of the rectum; M, muscularis propria; N, nodule; PVF, posterior vaginal fornix; PVW, posterior vaginal wall; TV, transvaginal.

(NPV) and positive and negative likelihood ratios, with 95% CI, of office gel SVG for the prediction of posterior compartment DIE involving the posterior vaginal wall, RVS, anterior rectum/rectosigmoid or USL. Fisher's exact test was used to evaluate the presence of an association between test result and diagnosis. The sensitivity, specificity, PPV and NPV were also calculated for the sliding sign in the prediction of POD obliteration.

RESULTS

Complete gel SVG and laparoscopic data were available for 189 of the 220 (86%) women enrolled; 31 women had gel SVG performed preoperatively, but chose not to undergo surgery after consultation with their surgeon. The mean ± SD age of the study group at gel SVG was 32.2 ± 7.5 years. The age at first diagnosis of endometriosis, which was confirmed at prior laparoscopy in the 92 women with a history of endometriosis, was 26.2 ± 6.1 years. Detailed patient characteristics are shown in Table 1.

At laparoscopy, 146 (77%) women had some form of endometriosis (endometrioma, peritoneal endometriosis, and/or DIE) and 57/189 (30%) women were found to have posterior compartment DIE. Table 2 displays the frequency and location of the posterior compartment DIE lesions as well as the frequency of POD obliteration, as predicted at gel SVG and confirmed at laparoscopy.

Bowel DIE (anterior rectum/rectosigmoid colon) was present at laparoscopy in 43/189 (23%) women and laparoscopic excision of bowel DIE was performed in 38/43 (88%) of these women. The POD was obliterated in 36/43 (84%) women with bowel DIE, while in seven (16%) the POD was found to be unobliterated at surgery. The sensitivity for the sliding sign in the prediction of POD obliteration was 85%, specificity was 98%,

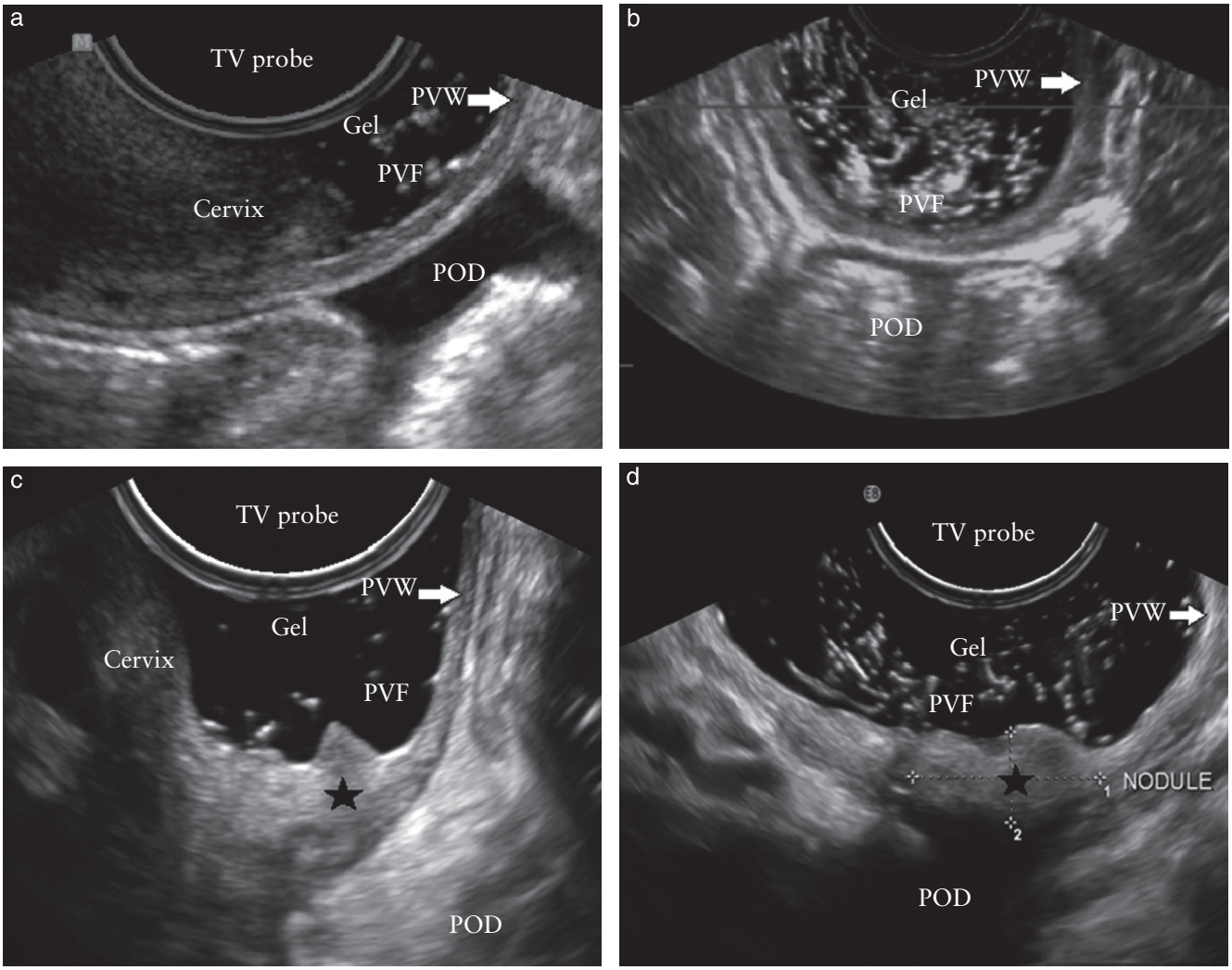

Figure 3 Visualization of posterior vaginal wall using sonovaginography. (a,b) Imaging in a woman with apparently normal posterior vaginal wall, displayed in sagittal (a) and transverse (b) planes. (c,d) Imaging in a woman with posterior vaginal wall deep infiltrating endometriosis nodule (★) in sagittal (c) and transverse (d) planes. POD, pouch of Douglas; PVF, posterior vaginal fornix; PVW, posterior vaginal wall; TV, transvaginal.

PPV was 93% and NPV was 95%. Bowel skip lesions involving the rectosigmoid and/or anterior rectum were present in 7/189 (4%) women.

For the prediction of posterior compartment DIE overall (anterior rectum, rectosigmoid, USL, RVS, and/or vagina) using office gel SVG, the sensitivity was 86%, specificity was 93%, PPV was 83% and NPV was 94%; values for the prediction of DIE according to individual posterior compartment locations are given in Table 3. Office gel SVG was more accurate in predicting rectosigmoid compared with anterior rectal DIE. Of the 189 women, 16 (8.5%) had vaginal, RVS, or both vaginal and RVS DIE, but only two of these cases were detected by gel SVG. However, 15 (94%) of these 16 women also had associated bowel DIE and POD obliteration at surgery, of whom 13 (87%) were correctly identified preoperatively as having bowel DIE and/or POD obliteration. The single case of vaginal and RVS DIE that was not associated with bowel DIE or POD obliteration at surgery was identified correctly with gel SVG.

DISCUSSION

To the best of our knowledge, this is the first study to describe the use of office gel SVG to predict posterior compartment DIE. We found office gel SVG to have a sensitivity and specificity comparable to those of TVS[9] for the prediction of bowel DIE (sensitivity, 88% *vs* 91%; specificity, 93% *vs* 98%), and we demonstrated high specificity and NPV for office gel SVG in the prediction of DIE of the anterior rectum, rectosigmoid, USL, RVS and vagina.

Two previous studies have compared saline SVG, in which saline was infused into the vagina to create an acoustic window, with TVS for the prediction of posterior compartment DIE[16,17]. In both, the detection of posterior vaginal wall DIE was improved using saline SVG, with sensitivities of 100% and 95%. In addition, Saccardi *et al.*[17] were able to demonstrate a sensitivity of 89% for USL and 81% for RVS DIE. Interestingly, both of these saline SVG studies had a much lower sensitivity

Table 1 Descriptive statistics of 189 women with suspected endometriosis who underwent office gel sonovaginography and laparoscopy, according to whether deep infiltrating endometriosis (DIE) of the posterior compartment was present at laparoscopy

		DIE present (n = *57*)		*DIE absent* (n = *132*)		
Patient characteristic	*Total* (n = *189*)	*Data missing* (n)	*Value*	*Data missing* (n)	*Value*	P
Age (years)	32.2 ± 7.5	0	33.1 ± 5.6	0	31.8 ± 8.1	0.28
Duration of pain (months)	39.7 ± 47.5	24	33.9 ± 37.4	36	41.7 ± 50.5	0.42
Age at diagnosis of endometriosis (years)	26.2 ± 6.1	22	28.3 ± 5.1	83	24.8 ± 6.4	0.009
Parity > 0	75 (39.7)	0	17 (29.8)	0	58 (43.9)	0.07
Parity > 1	51 (27.0)	0	5 (8.8)	0	46 (34.8)	0.0001
Previous NVD	49 (25.9)	2	7 (12.3)	5	42 (31.8)	0.006
Previous LSCS	25 (13.2)	2	7 (12.3)	6	18 (13.6)	1.0
Previous miscarriage	46 (24.3)	0	13 (22.8)	3	33 (25.0)	0.72
Previous ectopic pregnancy	8 (4.2)	0	0 (0)	3	8 (6.1)	0.11
Previous TOP	27 (14.3)	0	6 (10.5)	4	21 (15.9)	0.37
History of IVF	16 (8.5)	4	8 (14.0)	6	8 (6.1)	0.08
History of infertility	44 (23.3)	5	20 (35.1)	14	24 (18.2)	0.02
History of endometriosis	92 (48.7)	2	39 (68.4)	5	53 (40.2)	0.0004
History of bowel DIE	10 (5.3)	9	8 (14.0)	13	2 (1.5)	0.0008

Data are presented as mean ± SD analyzed by ANOVA, or *n* (%) analyzed by Fisher's exact test. IVF, *in-vitro* fertilization; LSCS, lower segment Cesarean section; NVD, normal vaginal delivery; TOP, termination of pregnancy.

Table 2 Location and frequency of posterior compartment deep infiltrating endometriosis (DIE) lesions and pouch of Douglas (POD) obliteration in 189 women with suspected endometriosis who underwent office gel sonovaginography (SVG) and laparoscopy

DIE location	*Gel SVG*	*Laparoscopy*
Bowel (anterior rectum and/or rectosigmoid)	38 (20.1)	43 (22.7)
Anterior rectum	26 (13.8)	36 (19.0)
Rectosigmoid	11 (5.8)	13 (6.9)
Skip bowel lesions	4 (2.1)	7 (3.7)
Vagina	2 (1.1)	11 (5.8)
Rectovaginal septum	2 (1.1)	11 (5.8)
Uterosacral ligaments	4 (2.1)	10 (5.3)
POD obliteration	40 (21.2)	47 (24.9)

Data are presented as *n* (%) of women. Multiple DIE lesions, or a contiguous DIE lesion involving more than one location, may have been present in the same patient. A total of 16 (8.5%) women had RVS, vaginal or both RVS and vaginal DIE at laparoscopy, in 15 of whom this was associated with both rectal DIE and POD obliteration.

for the prediction of bowel DIE (67%), compared with that of TVS (91%)[9] and with that of office gel SVG as observed in this study. The main advantage of using gel instead of saline as a distention medium during SVG is that gel SVG requires only one operator to insert the gel and perform the examination; saline SVG is a more cumbersome technique, requiring two operators (one person to instil saline into the vagina and one person to perform SVG).

Guerriero *et al.*[30] used a modified TVS 'tenderness-guided' approach to predict posterior DIE; this involved filling the probe cover with 12 mL ultrasound gel to create a stand-off effect. Tender regions during the TVS assessment were used to guide the determination of DIE location. The sensitivity and specificity were 67% and 92% for the detection of rectosigmoid DIE, 74% and 88% for RVS DIE and 91% and 89% for vaginal DIE.

Vaginal/RVS DIE is thought to be more difficult to visualize with TVS than are other types of DIE[4,5,11,31]. One of the aims, therefore, of this study was to determine whether using the stand-off approach with gel SVG could improve the detection of vaginal/RVS DIE. Although our ability to detect bowel DIE with gel SVG was comparable to that of TVS, and superior to that of previous SVG and 'tenderness-guided' TVS studies, the sensitivity for vaginal/RVS DIE was not nearly as encouraging. The poor detection rate in this study may be attributed partly to the low prevalence (8.5%) of these lesions in our study group. The gel SVG technique was, however, able to demonstrate a high specificity and NPV for vaginal/RVS DIE, which is important when deciding which women are suitable to undergo surgery performed by a general laparoscopic surgeon.

The findings of our study are consistent with those of previous studies, in that vaginal and RVS DIE were commonly associated with the presence of other DIE lesions[11,32]. In particular, 15/16 (94%) women with RVS or vaginal DIE in this study had a contiguous anterior rectal nodule and POD obliteration, which is important from both an imaging and a surgical perspective. In our experience, confirmation of RVS DIE with TVS/gel SVG is more difficult in the presence of a contiguous anterior rectal wall lesion. Although a normal RVS can be visualized clearly in its entirety along the posterior vaginal wall during gel SVG, delineation of the RVS becomes more difficult when anterior rectal lesions coexist and infiltrate/obliterate the RVS/vagina/POD. In this study there was only one case of RVS with vaginal DIE that was not associated with anterior rectal/rectosigmoid DIE and POD obliteration, and it was predicted correctly with gel SVG.

Table 3 Diagnostic accuracy of office gel sonovaginography for the prediction of posterior compartment deep infiltrating endometriosis (DIE), according to location

DIE location	*Accuracy (%)*	*Sensitivity (95% CI) (%)*	*Specificity (95% CI) (%)*	*PPV (95% CI) (%)*	*NPV (95% CI) (%)*	*LR+ (95% CI)*	*LR− (95% CI)*	P*
Bowel	92.1	88.4 (74.9–96.1)	93.2 (87.8–96.7)	79.2 (65.0–89.5)	96.5 (91.9–98.8)	12.9 (7.0–23.7)	0.12 (0.05–0.3)	3.98E–25
Rectosigmoid	94.7	84.6 (54.6–98.1)	95.5 (91.2–98.0)	57.9 (33.5–79.7)	98.8 (95.8–99.9)	18.6 (9.1–38.1)	0.16 (0.05–0.6)	2.65E–11
Ant. rectum	91.0	72.2 (54.8–85.8)	95.4 (90.8–98.1)	78.8 (61.1–91.0)	93.6 (88.5–96.9)	15.8 (7.4–33.5)	0.29 (0.17–0.5)	1.12E–17
PVW	94.7	18.2 (2.3–51.8)	99.4 (96.9–100.0)	66.7 (9.4–99.2)	95.2 (91.0–97.8)	32.4 (3.2–330.0)	0.82 (0.62–1.1)	0.0090
RVS	95.2	18.2 (2.3–51.8)	100.0 (96.9–100.0)	100.0 (9.4–100.0)	95.2 (91.1–97.8)	Inf (NaN–Inf)	0.82 (0.62–1.1)	0.0031
USL	94.7	40.0 (12.2–73.8)	97.8 (94.4–99.4)	50.0 (15.7–84.3)	96.7 (92.9–98.8)	17.9 (5.2–61.3)	0.61 (0.37–1.0)	0.0003

More than one DIE lesion, or a contiguous DIE lesion involving more than one location, may have been present in the same patient. *Fisher's exact test. Ant., anterior; Inf, infinity; LR+, positive likelihood ratio; LR−, negative likelihood ratio; NaN, not a number (represents an undefinable value); NPV, negative predictive value; PPV, positive predictive value; PVW, posterior vaginal wall; RVS, rectovaginal septum; USL, uterosacral ligaments.

Another important issue to consider is whether the preoperative detection of RVS DIE actually improves the surgical management in women with a contiguous anterior rectal lesion that has already been predicted with TVS or gel SVG. Of the 15 women in this study with undetected vaginal/RVS DIE, 13 (87%) were identified correctly by preoperative gel SVG as having bowel DIE and/or POD obliteration. Therefore, the preoperative counseling and work-up for the majority of women with undetected vaginal/RVS DIE was not compromised, as these women still underwent appropriate preoperative colorectal consultation and they were treated as a joint gynecological/colorectal laparoscopic case with appropriate bowel preparation preoperatively. Our experience indicates that advanced laparoscopic surgeons make their decision to excise RVS DIE not as a result of the ultrasound findings, but rather as a result of their findings during surgery, once the area of disease has been dissected.

The gel SVG operators in this study were not blinded to the prior vaginal examination findings, which presents a potential bias for the gel SVG findings, particularly for women with a vaginal/RVS nodule. However, the sensitivity of gel SVG for the prediction of vaginal and RVS DIE was quite low (18% and 18%), indicating that the lack of blinding of the gel SVG operator to the vaginal examination findings did not have a positive influence on the detection rate of vaginal or RVS DIE. Another possible source of bias of this study is that the surgeons were aware of the ultrasound findings prior to surgery. However, we felt that it would be unethical not to alert the surgeons to the preoperative imaging findings, because appropriate patient counseling and surgical planning would not have been provided preoperatively regarding the need for bowel surgery. A further criticism of this study may be that not all women underwent complete surgical exploration; however, this represented only three of the 47 women with POD obliteration, all three having a palpable rectal wall nodule at the level of the bowel adhesion to the posterior cervix/uterus.

Our study provides a starting point for evaluation of the office gel SVG technique in the prediction of posterior compartment DIE. We believe that, compared with TVS, gel SVG allows a clearer view of the contours of the posterior vaginal wall, posterior vaginal fornix/cervix and RVS. As such, gel SVG may be a useful tool for less experienced ultrasound operators when learning how to identify normal *vs* abnormal structures of the posterior compartment (i.e. analogous to using saline infusion sonography for improving identification of endometrial pathology). Studies with larger patient populations and sonologists/sonographers of different skill levels and experience, as well as intra-/interobserver reproducibility studies, are required in order to confirm the diagnostic accuracy and clinical applicability of the gel SVG technique for the prediction of posterior compartment DIE.

In conclusion, office gel SVG appears to be an effective imaging technique for the detection of bowel DIE, with a higher accuracy for the prediction of rectosigmoid compared with anterior rectal DIE. Although the sensitivity for prediction of vaginal and RVS DIE was limited, gel SVG was found to have a high specificity and NPV for all forms of DIE, indicating that a negative gel SVG examination strongly suggests the absence of DIE at laparoscopy. This new ultrasound technique may not only aid in the triaging of women for referral to an advanced laparoscopic surgeon (with or without input from a colorectal surgeon) but also act as a useful learning tool for visualization of the posterior pelvic compartment in women with suspected DIE.

ACKNOWLEDGMENTS

We would like to thank Dr David Kowalski and Dr Michael Cooper for their contribution to this study as advanced laparoscopic surgeons.

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SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Videoclip S1 Use of office gel sonovaginography (sagittal plane) to visualize deep infiltrating endometriosis of the rectum: identification of an anterior rectal wall nodule, which appeared as an elongated hypoechoic thickening in the normally linear muscularis propria of the anterior rectum.

Videoclips S2a–c 'Sliding sign' demonstrated during office gel sonovaginography. (a) Positive sliding sign. The anterior rectum glides smoothly across the posterior vaginal wall, indicating that the pouch of Douglas (POD) is not obliterated. (b) Positive sliding sign in the presence of an anterior rectal wall nodule. Note that the nodule glides smoothly across the posterior vaginal wall, indicating that the POD is not obliterated. (c) Negative sliding sign in the presence of an anterior rectal wall nodule: the rectum does not glide smoothly across the posterior vaginal wall at the site of the DIE nodule, indicating obliteration of the POD.