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REVIEW ARTICLE

Sonohysterography

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ABSTRACT

Sonohysterography (SHG) is a simple, less invasive, and inexpensive technique using the transcervical injection of sterile fluid during ultrasonic examination. As SHG is very helpful for the diagnosis of congenital or acquired abnormalities of the uterus and tubal patency, it is indicated in patients with abnormal uterine bleeding, infertility, recurrent pregnancy loss, and so on. The SHG provides better definition of intracavitary lesions, such as endometrial polyp, submucous leiomyoma, and synechiae, than simple transvaginal sonography. Currently, SHG has become a standard test in gynecological outpatient facilities. Adequate training, careful operations, and thoughtful interpretations are required for safe procedure and accurate diagnosis.

Keywords: Endometrial polyp, Infertility, Submucous leiomyoma, Tamoxifen.

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INTRODUCTION

Recent technical progress in the design of ultrasound devices has greatly improved the accuracy of diagnosing gynecological disorders. Transvaginal sonography (TVS) has allowed uterine and adnexal lesions to be visualized more clearly.

To increase the precision of diagnostic ultrasound procedures, abdominal sonography with saline instillation was developed by Nannini et al.[1] Parsons and Lense[2] then applied this method to TVS and called it sonohysterography (SHG). The negative contrast produced through the use of a physiological saline solution allows a lining of endometrium to grind distinctly, causing the shadow of an intrauterine mass to stand out. Color Doppler or three-dimensional (3D) imaging in addition to SHG is helpful in collecting even more information.[3] Thus, saline-infusion SHG is an extremely useful and easy-to-use technique, which has become a standard test in gynecological outpatient facilities.

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INDICATIONS

Abnormal Uterine Bleeding

The SHG is commonly used in cases of abnormal uterine bleeding in pre- and postmenopausal women. This is important as intrauterine abnormalities often cause metrorrhagia and/or hypermenorrhea. Standard TVS is able to show endometrial thickness, distortion of the endometrial lining, and abnormal constructions, while SHG allows the details of intrauterine abnormalities to be visualized (Figs 1 and 2). In addition, SHG can be used to provide a clinical diagnosis, such as endometrial polyps, submucosal leiomyoma, or endometrial carcinoma, thus enabling further strategies to be devised.

Patients with postmenopausal bleeding should be carefully examined because of the possibility of malignancy. In the Nordic multicenter study, the percentage of women with endometrial cancer increased in a linear fashion with increasing endometrial thickness: 35% of patients with an endometrial thickness of more than 10 mm had endometrial cancer,[4] whereas the probability of malignancy in postmenopausal patients with an endometrial thickness of less than 5 mm was much lower.[5,6] However, TVS measurements of endometrial thickness alone cannot rule out endometrial cancer, and endometrial biopsy might be necessary.

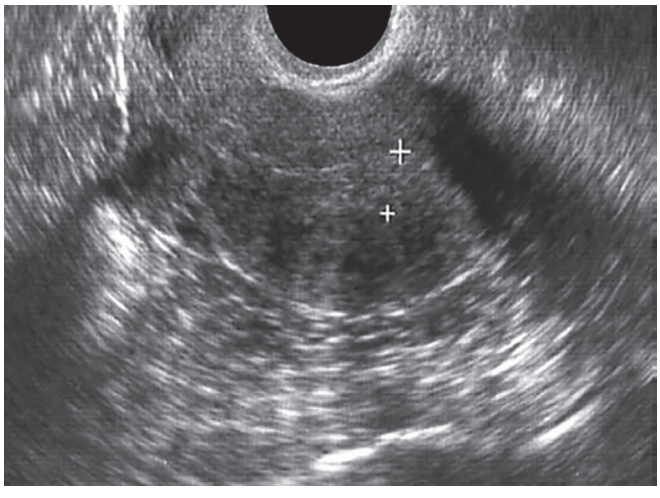

Fig. 1: Longitudinal scan of the uterus in a patient with postmenopausal bleeding before SHG. Thickness of hyperechoic endometrium is found about 9 mm

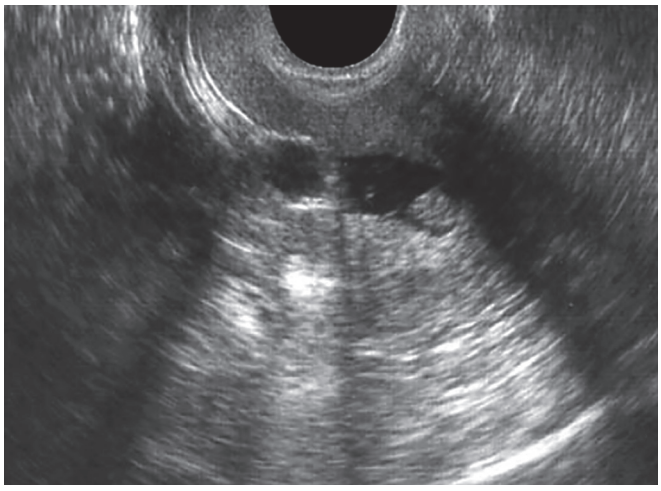

Fig. 2: Longitudinal scan of the patient during SHG. (An endometrial polyp is visualized on the fundus. Placement of a balloon is in the lower uterine cavity)

Because SHG has a potential to distinguish between diffuse endometrial thickening and focal intracavitary lesions,[7] it is useful in determining whether subsequent hysteroscopic biopsy is necessary.[8] If a focal lesion is observed using SHG, even if the imaging features suggest that it is benign, tissue diagnosis should be carried out.[9]

Tamoxifen-exposed Patients

Tamoxifen, which is one of the selective estrogen-receptor modulators, has been used as an adjuvant treatment for breast cancer. Tamoxifen decreases the risk of recurrence and death from breast cancer, but increases endometrial thickness and the risk of the formation of endometrial lesions, including carcinoma.

Hence, it is recommended that postmenopausal women taking tamoxifen should be closely monitored for symptoms of endometrial hyperplasia or cancer.[10] However, screening for endometrial cancer with routine TVS or biopsy has not been effective in asymptomatic women using this agent.[11] The SHG provides additional information about endometrial contours and has been used to detect subendometrial sonolucencies[12] or occult endometrial polyps in tamoxifen-treated patients.[13-15] Endometrial cancer has also been detected in two cases from asymptomatic patients.[16] Hence, SHG might be a useful technique in the assessment of endometrial pathologies in asymptomatic women taking tamoxifen.

Infertility

The SHG is widely used in the treatment of infertility, as it is necessary to check intrauterine abnormality and tubal patency during treatment. Hysterosalpingography (HSG) is routinely used to perform an initial investigation, but this method has disadvantages compared with SHG.[17-19] First, HSG requires the use of an iodinated contrast medium, which risks exposing the patient to ionizing radiation or inducing an allergic reaction. Second, HSG generally shows only the anteroposterior view; it might, therefore, be hard to get optimal results in the case of anteverted or retroverted uteri. Although HSG is useful for the evaluation of both tubal patencies, SHG has greater potential as a screening test for infertility.[20]

It is important to carry out an assessment of the uterine cavity before commencing treatment using assisted reproductive technology, such as *in vitro* fertilization (IVF). Diagnostic hysteroscopy is a gold standard tool for diagnosis of intrauterine abnormalities; however, a meta-analysis shows that SHG has a high degree of diagnostic accuracy in detection of all types of intrauterine abnormalities, with a sensitivity and specificity of 88 and 94% respectively, in comparison to hysteroscopy.[21] Moreover, there is a report that 3D SHG is superior to two-dimensional SHG significantly and comparable to hysteroscopy for diagnosis of intrauterine lesions in women of reproductive age.[22] Thus, the use of SHG is recommended as a screening test before embarking on an IVF program.[23]

Recurrent Pregnancy Loss

A high percentage of patients that repeatedly suffer pregnancy loss have either uterine anatomic disorders (e.g., congenital Müllerian anomalies) or acquired defects (e.g., uterine leiomyoma and uterine synechia). Consequently, the uterine cavity is the primary focus of anatomical screening in patients suffering recurrent miscarriage. The HSG produces a silhouette of the uterine cavity, and hysteroscopy shows an internal view of the uterus. Both techniques are clearly limited, as they do not allow assessment of the outer uterine contour and discrimination between septate and bicorunate uteri.[24] However, SHG allows the examination of both the outer and inner uterine bodies at the same time, and thus provides a more sensitive assessment.

In cases of severe synechia, SHG cannot assess the uterine cavity as precisely as hysteroscopy; however, it remains a highly sensitive, specific, and accurate screening tool for the evaluation of uterine-cavity defects that are associated with recurrent pregnancy loss.[25]

TECHNIQUE

In practice, the necessity of carrying out SHG is determined by the complaint as well as the results of an internal examination and TVS.

In premenopausal cases, SHG should be performed in the follicular phase of the menstrual cycle, after menstruation is completed. During the secretory phase, endometria will appear lobular in SHG. It is necessary to

perform SHG in the early proliferative phase to ensure accurate diagnosis. In postmenopausal patients with considerable hemorrhaging, SHG should be avoided and the examination should not be carried out until after the hemorrhaging has stopped.

The SHG is usually painless and well tolerated, however, postmenopausal women more often feel sharp pain than premenopausal women do.[26] The administration of Buscopan or nonsteroidal anti-inflammatory agents 30 to 60 minutes before SHG is recommended to reduce discomfort.[24] In addition, standard transvaginal ultrasound should be carried out to assess the endometrial lining and/or adnexal pathology before SHG. A speculum is inserted into the vagina after removal of the transvaginal transducer, and the cervix is visualized. After checking vaginal discharge, the external os of the cervix is cleansed fully with antiseptic solution and a catheter is then inserted into the external cervical os, taking care not to grasp the cervix.

An assessment of the instruments used in SHG was carried out by Dessole et al.[27] By comparing six different types of catheters, they showed that a catheter with an introducer is easiest to insert, and that a catheter without a balloon is less painful for patients. However, the type without a balloon allows high backflow into the vagina, and the assessment of the uterine cavity and/or tubal patency might be insufficient using this technique. Therefore, we generally use a catheter with a balloon and an introducer.

A catheter is introduced into the uterine cavity beyond the internal cervical os and the balloon is filled with as little air or fluid as possible to prevent a countercurrent of normal saline infusion. It is common to place the balloon just beyond the internal cervical os; however, intracervical placement of the balloon is less painful for the patient and allows observation of the lower part of the uterus.[28] After the placement of the catheter, the inner introducer is removed. A syringe containing warm saline is connected to the catheter and the transvaginal transducer is reinserted to verify the position of the catheter.

The standard position of the transvaginal transducer is sagittal (Fig. 3). After the air is released from the catheter, saline is injected slowly. The uterine cavity is observed initially while moving the probe from right to left, and then while moving it up and down, rotating the probe 90° counterclockwise (Fig. 4). If necessary, tubal flow and effusion into the cul-de-sac pouch can be observed. At the end of the procedure, the cervical canal and lower uterine segment are checked while deflating the balloon.

Images can be recorded in real time using photographic or video equipment. After the examination, it is important that the operator records all biometric and anatomic data immediately.[3]

FINDINGS

Endometrial Polyps

Endometrial polyps are the most common focal lesions occurring in uterine cavities. In the clinical diagnosis of endometrial polyps, SHG performs better than standard TVS and HSG.[8,17,18] Most cases show high echogenic shadow and endometrial thickness in standard TVS; however, it can be difficult to detect these phenomena distinctly. Figure 5 shows a typical endometrial polyp image produced by SHG. Saline infusion visualizes the endometrial polyps as homogeneous echogenic solid lesions with narrow peduncles. Using SHG, the shape, position, and number of endometrial polyps are easily clarified, and this information is useful in subsequent operative hysteroscopy.

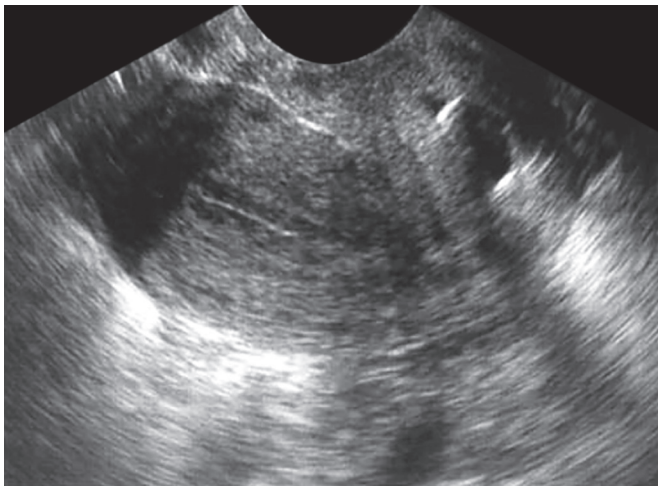

Fig. 3: Sagittal view of a normal uterus at day 11 of menstrual cycle. Endometrium is 8 mm in thickness and shows clear leaf pattern before saline infusion. A balloon is placed in the cervical canal

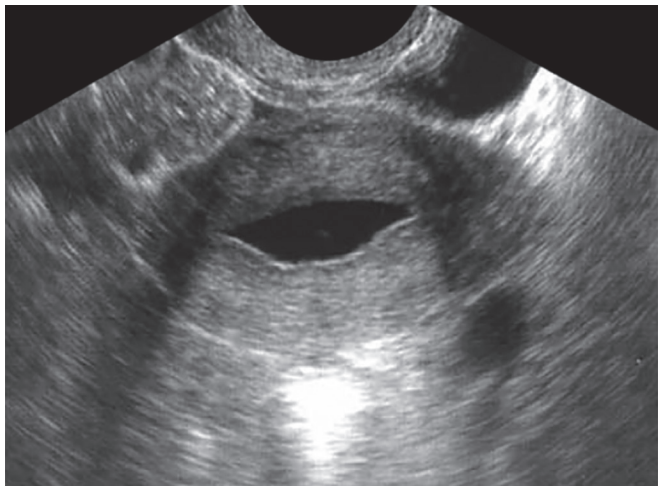

Fig. 4: Transverse view of the same case as in Figure 3. After saline infusion, the endometrium of proliferative phase shows the thin, hypoechoic, and homogeneous appearance

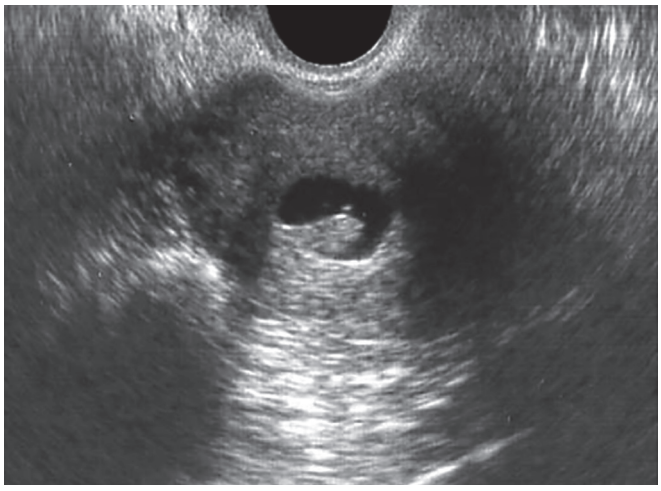

Fig. 5: Transverse view of a typical endometrial polyp during SHG. The lesion has homogeneously echogenic appearance and a narrow pedunculated attachment

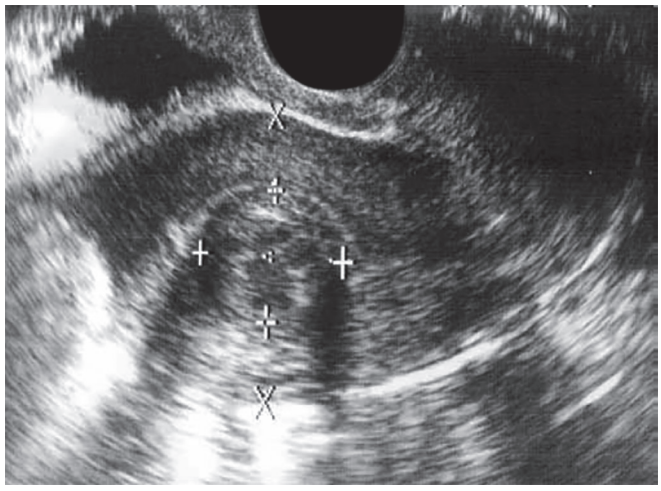

Fig. 6: Longitudinal view of a uterus of a premenopausal woman with hypermenorrhea and dysmenorrhea. A heterogeneous echogenic tumor with distorted endometrial lining suggests submucosal leiomyoma

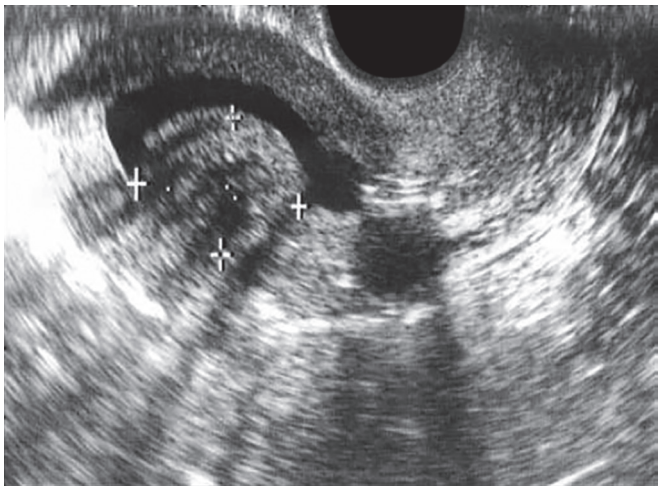

Fig. 7: After a saline infusion view of the same case as in Figure 6. The submucosal leiomyomas have a sessile attachment to the posterior uterine wall

A large endometrial polyp is difficult to distinguish from a small pedunculated leiomyoma using SHG. It has been reported that color Doppler SHG might be useful in distinguishing polyps from submucosal fibroids based on the vascularity of the lesions; i.e., polyps typically contain a single feeding vessel, whereas fibroids have several vessels.[29] However, there is no change in the treatment of hysteroscopic resection in either. The SHG alone is not sufficient for pathological diagnosis and additional studies are necessary for a complete diagnosis.

Submucosal Leiomyoma

Uterine leiomyoma is a common disease in women, and submucosal leiomyoma causes menstrual and reproductive disorders. Leiomyoma is visualized as a low echogenic shadow using TVS, whereas SHG reveals the contours of the leiomyoma (Figs 6 and 7) A systematic review has demonstrated that SHG and hysteroscopy show high accuracy in diagnosing submucosal fibroids.[30]

When deciding on an operative strategy, it is important to determine the size, location, and rate of protrusion of the fibroid into the uterine cavity before operating. It is especially difficult to perform the hysteroscopic removal of a fibroid with an intracavitary portion below 50%. The SHG can give a preoperative assessment of the submucosal grading; i.e., the measurement of the degree of intracavitary development.[31]

Tubal Patency

An intact fallopian tube is a poor sonic reflector, and both the detection and evaluation of the healthy tube are difficult using standard TVS. In SHG, the effusion of normal saline into the cul-de-sac space is a good indicator of tubal patency; however, each tubal patency is not easily detected. Several techniques are available for the detection of tubal patency. These include the use of agitated saline, ultrasound-contrast medium, saline with air, saline after air, and color Doppler flow.

The methods that employ agitated saline[32] and ultrasound-contrast medium[33,34] are similar. Agitated saline is prepared by shaking the syringe containing saline and air before infusion. This induces the formation of microbubbles that produce bright scintillating echoes on ultrasound, thus enabling visualization of the flow that passes through the fallopian tubes, as same as contrast medium. The Sion test, which involves pushing approximately 20 mL of saline and air through the catheter, also allows the observation of tubal patency.[35] It is reported that the flow of saline and micrometer-sized air bubbles is observed in transverse section.

Injection of air through the catheter, followed by saline, is another technique.[36] In this method, when air

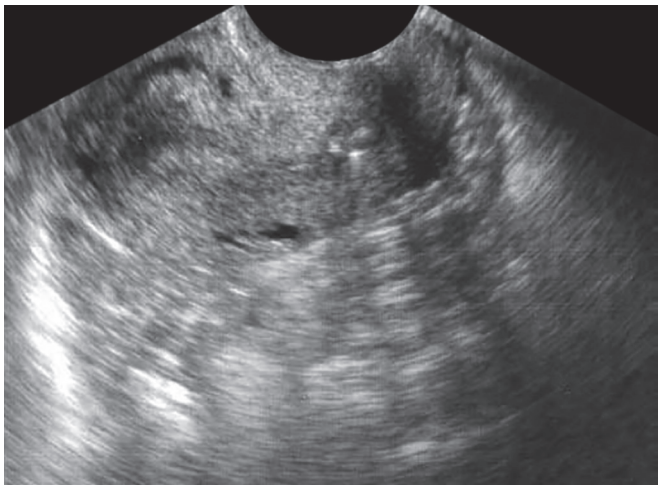

Fig. 8: A long-axis view of a patient with postmenopausal bleeding. Hyperechoic endometrial thickness is about 5 mm

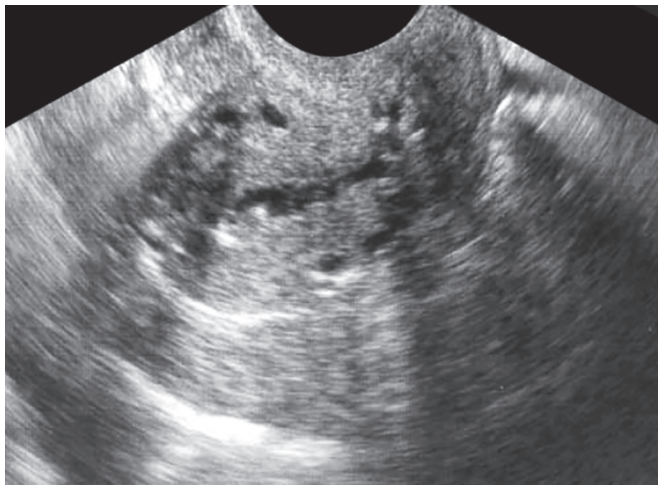

Fig. 9: Same view as Figure 8. A focal lesion with highly reflective irregular surface is shown. Histological diagnosis is endometrioid adenocarcinoma, G1

is injected, the lumen of the fallopian tube is visualized as a continuous or dotted hyperechoic thin line. Next, when saline is injected, air bubbles are disturbed and move rapidly through the solution. Then, when the whole course of the tube can no longer be visualized, the tubal patency can be evaluated through the detection of air bubbles moving around the ipsilateral ovary.

The SHG using color Doppler sonography is also performed in the assessment of tubal patency.[37-40] It is thought that the forward flow of saline for at least 5 seconds between the pars intramuralis and isthmus tubae without interruption and hydrosalpinx formation, and/or fimbrial turbulence to the cul-de-sac, indicates the presence of tubal patency.[41] Color flow is easier to visualize than contrast flow, and thus, there is a lower risk of error in the interpretation of results.

Hyperplasia and Cancer

The SHG is more sensitive than hysteroscopy in detecting hyperplasia.[42] The typical appearance of endometrial hyperplasia in SHG is irregular echogenic endometrial thickening, which is often distributed diffusely and occasionally distributed locally. When only local thickening is observed, the lesion should be sampled hysteroscopically to avoid the possibility of sampling error during office biopsy.[9]

The SHG findings of endometrial cancer are diverse. The lesions are generally hyperechoic and have irregular surfaces; however, size and shape can vary widely (Figs 8 and 9). The SHG might also have a role in preoperative staging by visualizing distortion of the endometrial–myometrial interface that suggests myometrial invasions.[43]

In the case of cancer, there is a potential risk that saline infusion might transport malignant cells into the peritoneal cavity during the SHG procedure. According to cytological analyses of the fluid spilled from the fimbrial ends during 10 to 20 mL saline infusion into the uterine cavity at the time of laparotomy, malignant cells were present in the spilled fluid in only one case out of 14.[44] Although the risk associated with SHG appears to be lower than that associated with hysteroscopy for small volume and low pressure, the risk of the dissemination of malignant cells still exists. It would, therefore, be prudent to perform SHG for all patients with endometrial cancer.

COMPLICATIONS

There are no major complications in SHG; however, patients should be counseled about the possibility of infection. The risk of intracavitary infection after SHG is reported to be slightly over 1%.[45] Although routine use of antibiotic prophylaxis is not recommended, consideration should be given to administering antibiotics based on individual risk factors.[46]

Genital infections, such as vaginitis, adnexitis, and pelvic inflammatory disease, are contraindications of this procedure. If necessary, SHG can be used after the inflammation is cured. Prophylactic antibiotics or cervical culture can be administered before SHG is performed. The exclusion of patients with mucopurulent discharge is another method to avoid the development of an infectious complication without prophylactic antibiotics.[47]

To avoid intracavitary infection, all procedures should be performed under strictly aseptic conditions. To ensure safety, the American College of Obstetricians and Gynecologists assessment recommends that endovaginal transducers undergo appropriate antimicrobial and antiviral reprocessing between patients.[46]

The patient should be instructed to expect leaking of fluid after the examination, and to contact her physician

if she develops fever, persistent pain, or unusual bleeding following the procedure.[3]

COMMENTS

The SHG has proved to be a useful tool in the clinical gynecological field, and appears to be a simple and easy procedure to use after TVS in outpatient clinics. However, as with most procedures, SHG is subject to a learning curve.[48] Careless performance and indiscreet judgment can lead to misdiagnosis through either false-positive or false-negative results. The injection of air bubbles, shearing the endometrium by rough catheter insertion, and shadowing of the catheter and balloon can produce iatrogenic effects that might cause false-positive results. The presence of a blood clot might also lead to an incorrect diagnosis.[49] To avoid misdiagnoses, careful operations and thoughtful interpretations are required. Furthermore, making a diagnosis of tubal patency demands considerable technical skill. Adequate training is, therefore, essential in order to become fully competent in the use of SHG.

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