

Comparison between 2D sonohysterography, 3D sonohysterography, and diagnostic hysteroscopy for assessment of intrauterine lesions in premenopausal bleeding patients and their correlation with the histopathology

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Received 23 January 2014
Accepted 20 February 2015

Evidence Based Women's Health Journal
2015, 5:53–60

Objective

The aim of the study was to compare the accuracy of 2D saline-infusion sonohysterography (2D-SIS), 3D saline-infusion sonohysterography (3D-SIS), and hysteroscopy in the assessment of intracavitary uterine lesions in women with premenopausal bleeding and determine their correlation with the histopathological diagnosis. We also aimed to follow the treatment plan of each case according to the diagnosis reached.

Study design

The study was prospective in design.

Materials and methods

Eighty premenopausal women with abnormal uterine bleeding and suspected intracavitary lesions were subjected to 2D saline sonohysterography, 3D saline sonohysterography, and diagnostic hysteroscopy. They were further managed accordingly.

Results

2D-SIS had a sensitivity, specificity, positive predictive value, and negative predictive value of 86.4, 92.3, 88.7, and 91.3%, respectively, when compared with diagnostic hysteroscopy for the diagnosis of intracavitary lesions. In contrast, 3D-SIS had a sensitivity, specificity, positive predictive value, and negative predictive value of 99.3, 98.7, 93.4, and 97.54%, respectively.

Conclusion

2D and 3D sonohysterography can accurately diagnose and localize intracavitary lesions almost as accurately as hysteroscopy. 3D-SIS is comparable to hysteroscopy in classifying fibroids according to their degree of protrusion into the uterine cavity and can assess feasibility for hysteroscopic resection, with the advantage of visualizing the intramyometrial portion and identifying associated pathologies. Their accuracy in estimating the protrusion index of fibroids declines as the intramural component increases.

Keywords:

fibroid, histopathology, hysteroscopy, polyps, premenopausal bleeding, 3D sonohysterography, 2D sonohysterography

Evid Based Women Health J 5:53–60
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2090-7265

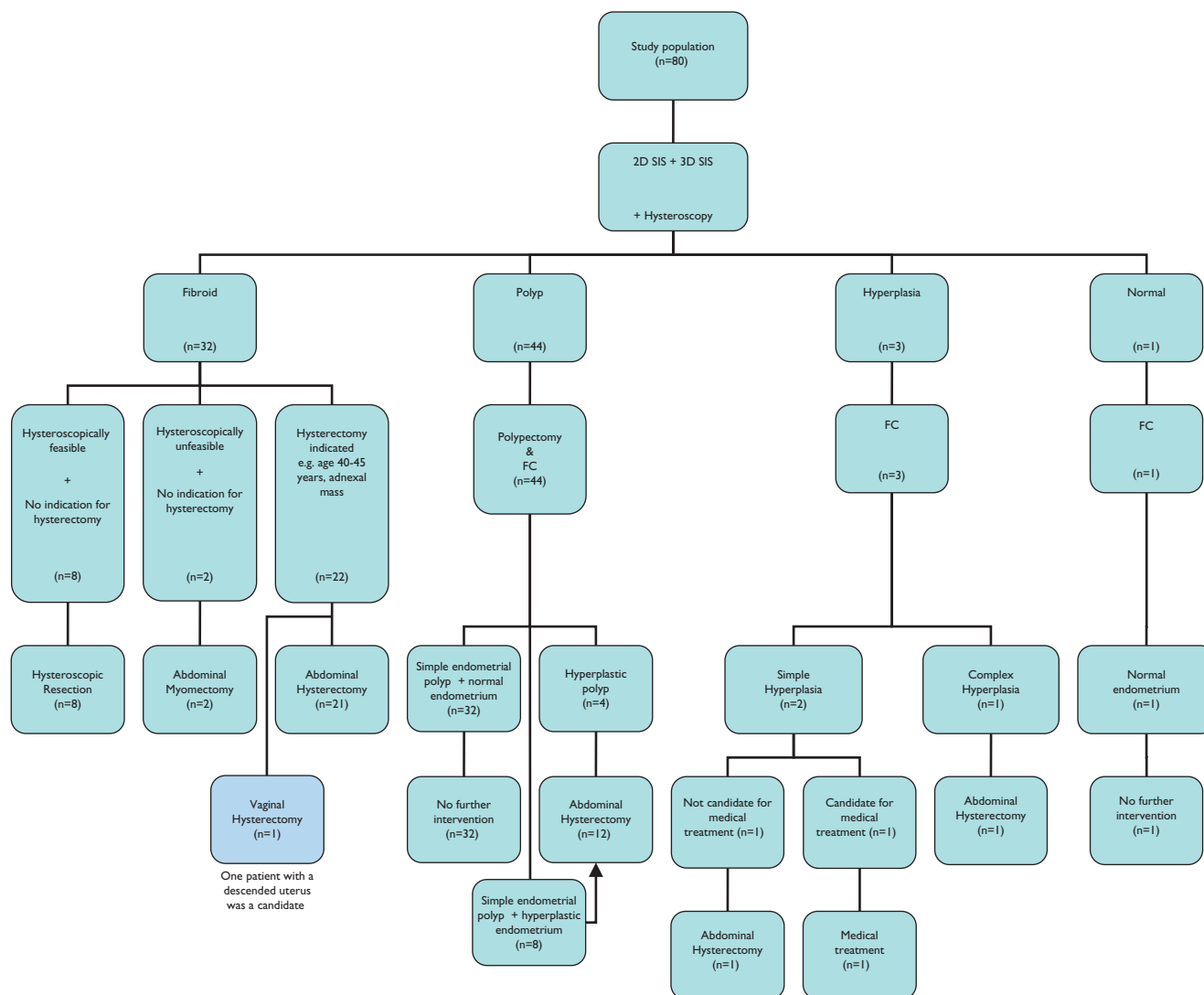
Introduction

Abnormal uterine bleeding is a common problem that accounts for up to 30% of outpatient visits to gynecologists [1–3]. In premenopausal women, it is the single most common reason for gynecological referrals. In more than 40% of referred patients, polyps and myomas have been reported [4]. Saline-infusion sonohysterography (SIS) is an easy-to-perform, safe, and well-tolerated procedure, yielding high diagnostic accuracy [5]. It has few contraindications and virtually no complications [6]. Its diagnostic accuracy is superior to that of sonography and very close to that of diagnostic hysteroscopy (DH), especially with intracavitary lesions such as endometrial polyps and submucous fibroids [5].

3D sonohysterography combines the advantages of conventional sonohysterography with the advantage of the third dimension. Several authors concluded that it may replace DH [7]. Although hysteroscopy could still be considered an invasive diagnostic procedure, in all studies it is considered the gold standard for evaluation of the uterine cavity [8].

The purpose of this study was to compare the diagnostic accuracy of two-dimensional SIS (2D-SIS), three-dimensional SIS (3D-SIS), and DH in the assessment of intracavitary uterine lesions in women with premenopausal bleeding, and determine their correlation with the histopathological diagnosis. We also aimed to follow the treatment plan of each case, according to the diagnosis reached.

Figure 1



Different lines of management in the study group.

Materials and methods

Eighty premenopausal patients complaining of abnormal uterine bleeding and suspected to have an intrauterine lesion by conventional transvaginal sonography – out of 228 women with premenopausal bleeding – were recruited from the outpatient gynecology clinic, Kasr Alainy Hospital, Cairo University, from July 2012 to March 2014. The Ethics Committee of Cairo University approved the study protocol. Informed consent was obtained from all participants after the nature of the procedure had been fully explained to them. Their ages ranged between 40 and 52 years with a mean of 44.5 ± 2.84 years. Their parity ranged between 0 and 12, with a mean of 4.62 ± 2.47 . All of them were subjected to full history taking and other examinations – general, abdominal, and pelvic – followed by 2D-SIS, 3D-SIS, and DH; the results were correlated to the histopathology.

With an empty bladder and in lithotomy position, 2D-SIS was performed by instilling saline using a 6–8 Fr Foley

catheter passed into the uterine cavity through the cervix. The amount of instilled fluid varied, depending on the distension of the endometrial cavity as seen on the ultrasound monitor, and also on patient comfort. Then, sonography was carried out by one of two examiners (Abd El Kader M.A. and Gad Allah S.H.) using a Voluson 730 Pro (General Electric Healthcare, Tiefenbach, Austria) ultrasound machine, with a real-time 4D micro-convex endovaginal curved linear probe (RIC5-9W) with frequency 5–9 MHz. During SIS the whole uterine cavity was meticulously and systematically scanned from one side to the other on a sagittal section through the uterus, and from the bottom to the top of the uterine cavity on a transverse section through the uterus. The 3D volume box was then applied covering the entire uterus, and then a 3D volume was generated by the automatic sweep of the mechanical transducer. The volume was stored digitally and analyzed off-line. The sonographic diagnosis of ‘endometrial polyp’ was given to those intracavitary lesions that were well defined, homogeneous, isoechoic or hyperechoic to the endometrium, and had a preserved endometrial–myometrial

Table 1 Histopathological diagnoses in the study group

	Number (%)
Endometrial polyp	44 (55)
Simple endometrial polyp	
With normal endometrium surrounding it	32 (40)
With simple hyperplasia surrounding it	8 (10)
Hyperplastic polyp	4 (5)
Leiomyoma	32 (40)
Endometrial hyperplasia	3 (3.75)
Simple hyperplasia	2 (2.5)
Complex hyperplasia	1 (1.25)
Normal endometrium	1 (1.25)
Total	80 (100)

Table 2 Comparison between 2D-SIS and 3D-SIS compared with DH regarding the estimation of size of endometrial polyps (values in cm)

	Mean	SD	P value
2D-SIS	3.33	0.72	> 0.05
3D-SIS	3.57	0.63	
DH	3.20	0.50	

DH, diagnostic hysteroscopy; 2D-SIS, two-dimensional saline-infusion sonohysterography; 3D-SIS, three-dimensional saline-infusion sonohysterography.

interface. Meanwhile, the diagnosis of 'submucous fibroid' was for a well-defined, broad-based lesion, hypoechoic or isoechoic, distorting the endometrial–myometrial interface.

Submucous fibroids were also assessed for their protrusion index into the uterine cavity, which was calculated using the formula $B/(B+A) \times 100$, where A is the intramyometrial portion of the fibroid and B is its intracavitary portion.

Detailed hysteroscopic examination was performed for all patients under general anesthesia by Aboul Nasr A. L. The light source used in this study was a metal halide automatic light source (Circon/ACMI G71A; Circon corporation, California, Santa Barbara, USA) with a 150W lamp connected to the hysteroscope through a fibro-optic cable. Constant uterine distention was performed by attaching plastic bags of distilled water. Infusion pressure was elevated by pneumatic cuff under manometric control at a pressure of 100–120 mmHg. The procedure was monitored using a single chip video and the image was displayed on a monitor visible to the operator. The camera was a Karl Storz camera (KARL STORZ GmbH & Co. KG, Tuttlingen, Germany) with a focal length varying from f70 to f140. The hysteroscopist had no knowledge of the ultrasound findings when performing the hysteroscopy. Hysteroscopic diagnosis of 'endometrial polyp' was made when the intracavitary lesion was exophytic, with surface epithelium similar to that of the endometrium, and floating away upon contact with the tip of the hysteroscope. Meanwhile, a 'submucous fibroid' was defined as a lesion that was covered by the endometrium, but when palpated with the tip of the hysteroscope revealed resistance and could not be pushed away from the hysteroscope.

Patients in the study group were followed up for further management. Thirty-two patients (40%) underwent polypectomy and fractional curettage with no further

Table 3 Comparison between 2D-SIS and 3D-SIS compared with DH regarding estimation of size of submucous fibroids (values in cm)

	Mean	SD	P value
2D-SIS	7.21	0.89	0.196
3D-SIS	6.71	0.66	
DH	6.60	0.60	

DH, diagnostic hysteroscopy; 2D-SIS, two-dimensional saline-infusion sonohysterography; 3D-SIS, three-dimensional saline-infusion sonohysterography.

Figure 2

2D-SIS showing a pedunculated endometrial polyp.

intervention, 12 patients (15%) underwent polypectomy and fractional curettage followed by hysterectomy in another setting, 2 (2.5%) underwent fractional curettage alone, 2 (2.5%) underwent fractional curettage followed by hysterectomy in another setting, and 8 (10%) underwent hysteroscopic myoma resection. Twenty-one patients (26.25%) were candidates for abdominal hysterectomy, 2 (2.5%) for abdominal myomectomy (2.5%), and one (1.25%) for vaginal hysterectomy.

Results

Three abnormal bleeding patterns were recognized; menometrorrhagia was the most common bleeding pattern, $n = 40$ (50% of all cases), followed by menorrhagia, $n = 24$ (30% of all cases), and metrorrhagia, $n = 16$ (20% of all cases). Two main pathological lesions were encountered in the study group – namely, endometrial polyp [44/80 (55%)] and fibroid [32/80 (40%)]. Because of the high diagnostic accuracy of hysteroscopy, it was used in our study as the gold standard to which 2D and 3D SIS were compared with regard to localization of lesions, estimating their sizes and degree of protrusion. The final pathological diagnosis was based on the histopathological examination, to which the three diagnostic methods were compared. Table 1 summarizes the different diagnoses encountered in the study group.

Figure 3



2D-SIS showing a type 1 fibroid.

Figure 4



2D-SIS showing a type 2 fibroid.

As expected, the diagnostic accuracy of DH for all lesions – whether or not protruding in the cavity – was 100%. 2D and 3D SIS showed 100% accuracy in the diagnosis of intracavitary lesions, such as polyps and submucous fibroids. However, 2D-SIS may misinterpret other lesions, giving it an overall accuracy of 97.5%. Three (3.75%) of the 80 patients recruited into the study as having an intracavitary lesion were discovered to have endometrial hyperplasia, and one (1.25%) had a normal endometrium. These four patients were diagnosed by 3D-SIS and hysteroscopy. Meanwhile, 2D-SIS falsely diagnosed the case of normal endometrium and one of the three cases of hyperplasia as having endometrial polyps. This false-positive result – misinterpreting a thick endometrium for a polyp – is stated in the literature [9,10]. Both 2D and 3D SIS accurately localized intracavitary lesions, where 2D-SIS had a sensitivity, specificity, positive predictive value, and negative pre-

Figure 5



3D-SIS showing a pedunculated endometrial polyp.

Figure 6



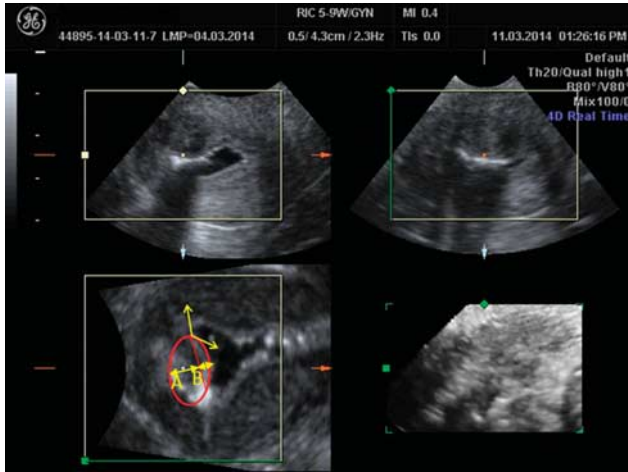
3D-SIS showing multiple endometrial polyps.

dictive value of 86.4, 92.3, 88.7, and 91.3%, respectively, when compared with DH. 3D-SIS had a sensitivity, specificity, positive predictive value, and negative predictive value of 99.3, 98.7, 93.4, and 97.54%, respectively. Moreover, these two modalities accurately estimated the size of lesions when compared with hysteroscopy (Tables 2 and 3).

As regards the protrusion index of fibroids, 2D-SIS accurately diagnosed seven of eight type 0 fibroids (87.5%), 6/8 (75%) type 1 fibroids, 6/9 (66.7%) type 2 fibroids, and 5/7 (71.4%) intramural fibroids. The accuracy of 3D-SIS was 8/8 (100%) for type 0 fibroids, 7/8 (87.5%) for type 1 fibroids, and 7/9 (77.8%) for type 2 fibroids.

Patients in the study group were followed up with regard to further management (Fig. 1) after sonohysterography and DH (Figs 2–17).

Figure 7



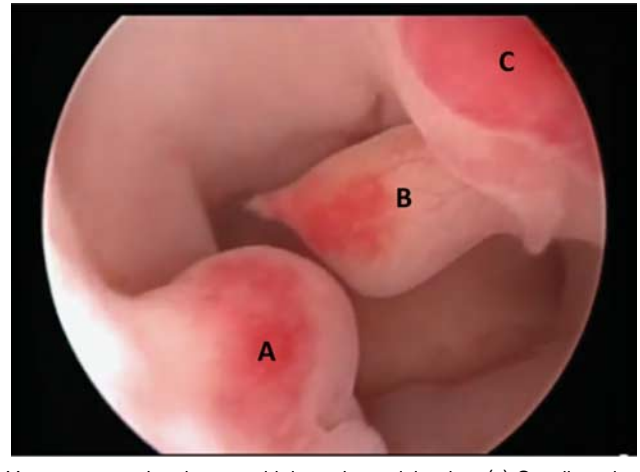
3D-SIS showing a type 2 fibroid. Less than 50% of the fibroid is in the uterine cavity, with an angle more than 90°. (a) The intramyometrial portion of the fibroid. (b) The intracavitary portion of the fibroid.

Figure 8



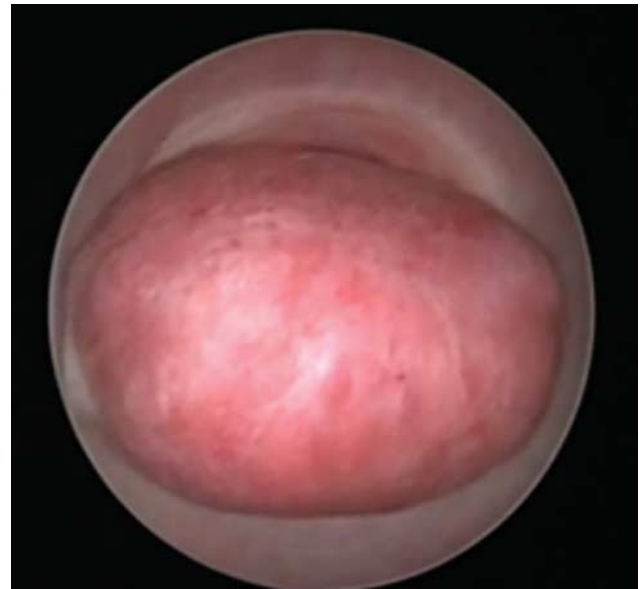
Hysteroscopy showing an endometrial polyp.

Figure 9



Hysteroscopy showing a multiple endometrial polyp. (a) Sessile polyp, (b, c) pedunculated polyp.

Figure 10



Diagnostic hysteroscopy showing a type 0 fibroid. The whole fibroid is in the uterine cavity.

Discussion

The outstanding accuracy of hysteroscopy in diagnosing intracavitary lesions is in line with the studies of Kelekci *et al.* [11], Karageyim Karsidag *et al.* [12], and Bingol *et al.* [5]. In their study on 50 patients (26 of whom had abnormal uterine bleeding), Kelekci *et al.* [11] found the diagnostic accuracy of hysteroscopy to be 95%. Similarly, in the work of Karageyim Karsidag *et al.* [12] on focal intrauterine lesions in 36 patients, hysteroscopy was proved to have a sensitivity of 100%. In a larger study conducted by Bingol *et al.* [5] on 346 patients the sensitivity of hysteroscopy was 98%.

2D-SIS has 100% accuracy in the diagnosis of intracavitary lesions, such as polyps and submucous fibroids.

However, it may misinterpret other lesions – as mentioned above – giving it an overall accuracy of 97.5%.

The high accuracy of 2D sonohysterography with intracavitary lesions – mainly polyps and submucous fibroids – is supported by several studies [5,11,13–17]. Table 4 summarizes a comparison of our present results with those of formerly mentioned studies.

The high diagnostic accuracy of the relatively new imaging modality – 3D sonohysterography – was not a surprise. Several studies have previously demonstrated that 3D-SIS has an accuracy approaching 100% in the detection of intrauterine polyps and fibroids [14,17,19,22,23]. A comparison of

Figure 11



Diagnostic hysteroscopy showing a type 1 fibroid. More than 50% of the fibroid is in the uterine cavity, with an angle less than 90°.

Figure 12



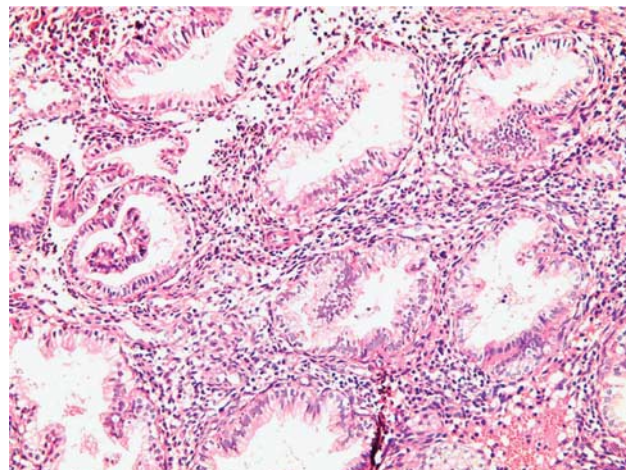
Diagnostic hysteroscopy showing a type 2 fibroid. Less than 50% of the fibroid is in the uterine cavity, with an angle more than 90°.

our results with the results of the mentioned studies is illustrated in Table 4.

Sonohysterography offered the advantage of visualizing the intramyometrial portion of the fibroid, associated intramural or subserous fibroids, and associated adnexal lesions.

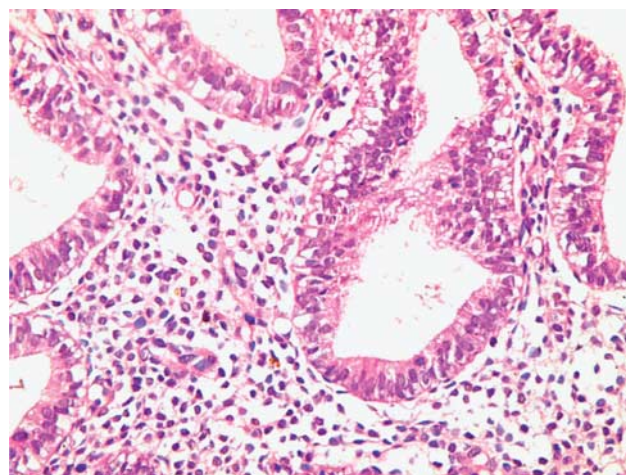
We noticed that the accuracy of sonohysterography – whether 2D or 3D – in estimating the protrusion index of fibroids declines when the intramural component increases. Meanwhile, the accuracy is higher when the intracavitary portion of the fibroid is larger. This is line with studies by Salim *et al.* [24] and Bartkowiak *et al.* [25]. In the study by Salim *et al.* [24] to compare 3D-SIS and

Figure 13



H&E picture of a benign endometrial polyp (× 200).

Figure 14

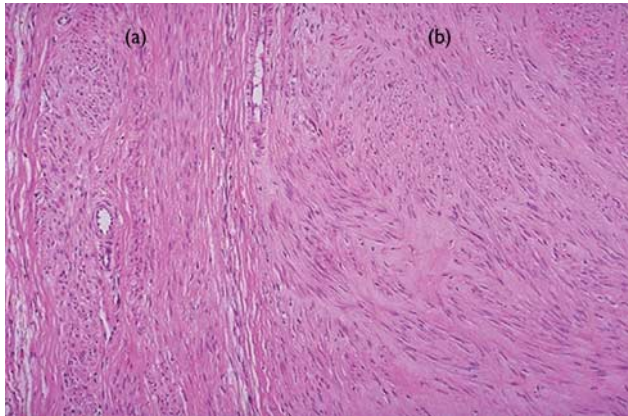


H&E picture of a hyperplastic polyp (× 400).

DH for the classification of submucous fibroids, a total of 61 submucous fibroids were identified in 49 symptomatic women. There was agreement between the two methods in 11/12 cases of type 0 fibroids (92%), in 34/37 cases (92%) of type I fibroids, and in 9/12 cases (75%) of type II fibroids. Similarly, in the work of Bartkowiak *et al.* [25] on 68 premenopausal women, 74 submucous myomas were identified. 3D-SIS agreed with hysteroscopy in 95% (20/21) of cases with type 0 myomas, in 88% (31/35) of cases with type I myomas, and in 77% (14/18) of cases with type II myomas.

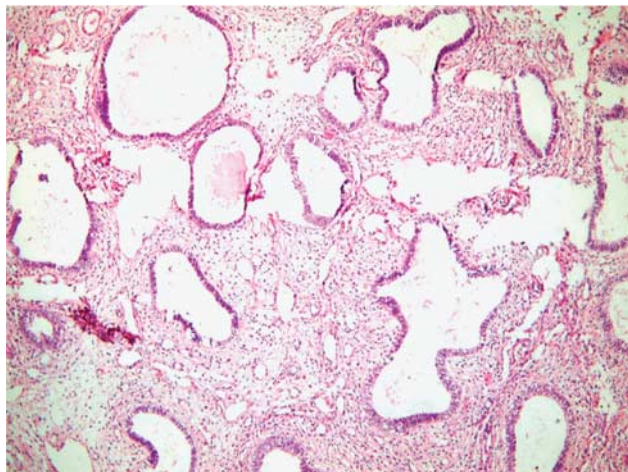
We must emphasize that endometrial polyps – the most common finding in premenopausal bleeding patients – are accurately diagnosed by SIS and hysteroscopy, and that hysteroscopy provides an opportunity for treatment by polypectomy in the same setting. Furthermore, if curettage of the surrounding endometrium shows no additional pathology, the patient will not need any further

Figure 15



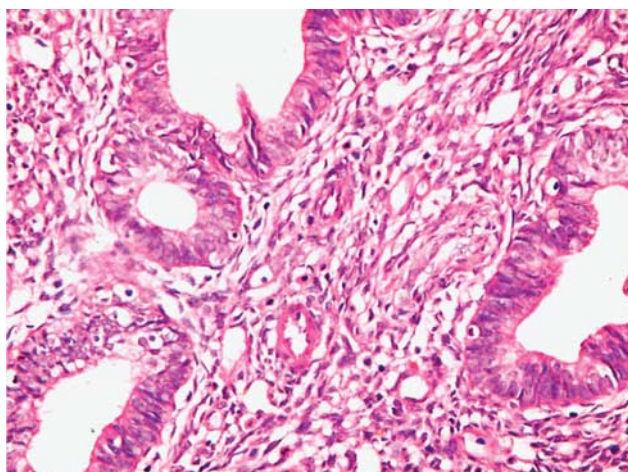
H&E picture of leiomyoma (x100). (a) Normal myometrium. (b) The neoplasm is well differentiated so that it hardly appears different from the normal myometrium, apart from being formed of interlacing bundles of smooth muscle.

Figure 16



H&E picture of a simple endometrial hyperplasia (x100).

Figure 17



H&E picture of a complex endometrial hyperplasia (x400).

Table 4 A comparison between the results of previous studies and our results regarding overall sensitivity, specificity, and positive and negative predictive values of 2D-SIS, 3D-SIS, and DH in the assessment of uterine lesions

References	N	Menstrual state	2D-SIS (%)				3D-SIS (%)				DH (%)			
			Sens	Spec	PPV	NPV	Sens	Spec	PPV	NPV	Sens	Spec	PPV	NPV
De Vries et al. [13]	62	Pre	88	95	-	-	-	-	-	-	-	-	-	-
Sylvestre et al. [14]	209	Rep	98	100	100	98	100	100	100	100	100	100	100	100
Kelekci et al. [11]	41	Pre + Post	81	100	100	90	100	100	92	100	100	100	100	93
Alborzi et al. [18]	80	Pre + Post	94	95	96	90	95	96	-	-	-	-	-	-
Aslam et al. [15]	100	Pre + Post	93	90	87	95	90	87	-	-	-	-	-	-
Erdem et al. [16]	122	Pre + Post	98	82	94	93	82	94	-	-	-	-	-	-
Mora-Guanche et al. [19]	111	Rep	-	-	-	-	-	-	100	100	100	100	100	100
Sconfienza et al. [17]	24	Rep	90	100	60	100	100	60	100	100	100	100	100	100
Grimbizis et al. [20]	105	Any	91	65	-	100	65	-	-	-	-	-	-	85
Bingol et al. [5]	137	Post	90	77	95	58	77	95	-	-	-	-	-	81
Khan et al. [21]	55	Any	-	-	-	-	-	-	98	100	98	100	100	98
Aboughar et al. [22]	77	Rep	87	100	100	84	100	100	100	100	100	100	100	100
Adel et al. [23]	26	Pre	-	-	-	-	-	-	100	100	100	100	100	100
This study	80	Pre	86	92	89	91	92	89	93	99	93	98	100	100

DH, diagnostic hysteroscopy; NPV, negative predictive value; post, postmenopausal; PPV, positive predictive value; pre, premenopausal; Rep, reproductive age; Sens, sensitivity; SIS, saline-infusion sonohysterography; Spec, specificity.

management. Adopting this policy will avoid the patient's exposure to any unnecessary procedure.

Another important finding in our work is the role of 3D-SIS in planning the management of submucous fibroids. When patients are found to have concomitant intramural or subserous fibroids, hysteroscopy will not be a suitable choice and the management should be either by abdominal myomectomy or by hysterectomy from the start. Moreover, 3D-SIS can accurately estimate the degree of extension of submucous fibroids into the cavity and determine feasibility for subsequent hysteroscopic resection. When proposed resectable, hysteroscopy should be carried out from the start by an expert hysteroscopist to spare the patient an unnecessary second setting.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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