Section: Radiology

Original Research Article

DIAGNOSTIC SUPERIORITY OF GEL SONOVAGINOGRAPHY OVER TRANSVAGINAL SONOGRAPHY IN EVALUATING INCIDENTALLY DETECTED CERVICAL AND VAGINAL LESIONS: A CROSS-SECTIONAL OBSERVATIONAL STUDY

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Abstract

Background: The objective is to evaluate the diagnostic advantage of using gel sonovaginography in imaging incidentally detected pathologies of lower genital structures including cervical and vaginal disorders in comparison to standard transvaginal sonography. **Materials and Methods:** A cross-sectional observational study comprising of 32 patients underwent transvaginal sonography was followed by gel sonovaginography. Data was collected in the form images and stored as soft copies. Images were interpreted by two radiologists to avoid bias. Correlation of the sonographic results were done with clinical, surgical, histopathological and MRI findings was done wherever possible. **Result:** Gel sonovaginography was able to detect the pathology in all patients who were incidentally found to have cervical or vaginal pathology on transvaginal ultrasound prior to clinical examination. The cervical lesions were well-delineated on gel sonovaginography with excellent characterization of their location, margins and extension as opposed to transvaginal sonography. Gel sonovaginography was able to detect all the vaginal lesions some of which were not well visualized on transvaginal sonography. The origin, margins and vaginal wall involvement were detected well on gel sonovaginography. **Conclusion:** Gel sonovaginography improves the detection, visualization and delineation of cervical and vaginal masses due to distension of the vagina by the introduced gel forming an acoustic window between the anatomical structures and/or lesions and the probe. Gel sonovaginography overcomes the limitations of transvaginal sonography.

INTRODUCTION

Vaginal and cervical disorders span a wide range, including genital tract malformations, neoplasms and deep infiltrating endometriosis. In patients undergoing ultrasonographic examination for gynaecological symptoms, many clinically undetected pathologies involving cervix and vagina are found incidentally. With lack of clinical details regarding these lesions, their evaluation always poses a diagnostic dilemma.[1-3]

Transvaginal sonography (TVS) is widely preferred due to its high sensitivity, accessibility, and cost-effectiveness2. However, transvaginal sonography may underdiagnose lesions of the cervix and vagina due to their close proximity to the transducer. Various techniques have been explored to improve transvaginal imaging by creating a standoff between the probe and the lesion to enhance visualization.[4-6] Gel sonovaginography (GSV) offers a novel approach by introducing ultrasound gel into the vagina, followed by performing transvaginal sonography. The gel creates a standoff, partially distends the vaginal walls thus improving visualization of the cervix, vaginal walls and associated pathologies1. Additionally, the gel gently expands the upper vagina and spreads around the lesion, clarifying tissue planes and lesion boundaries.[7,.8]

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MATERIALS AND METHODS

This was a cross-sectional observational study conducted for a period of one year which included a total of 32 patients referred to the Department of Radiodiagnosis for Ultrasonography of pelvis. Study was done after the approval by Institutional Ethical Committee (IEC) and review board.

Patients who were referred to ultrasound and were incidentally detected with cervical and/or vaginal lesions were included in the study. Patients with active bleeding per vaginum, lower genital mass completely obliterating vaginal canal, virgo intacta and active infection were excluded from the study. Relevant patient data were noted. The procedure was explained to the patient and written consent was obtained in every case. The patients underwent transvaginal sonography followed by gel sonovaginography.

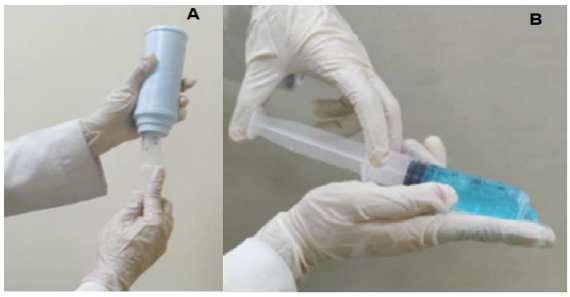


Figure 1: (1A) A fresh bottle of ultrasound gel is held upside down in the left hand, while a 20 ml syringe is inserted into the bottle with the right hand. The plunger is stabilized with the thumb and ring finger, and the barrel is slowly pushed upward using the index finger to fill the syringe. (1B) The syringe is held between the index and middle fingers of the right hand and gently guided into the vagina. The plunger is then pressed to release the gel into the vaginal canal

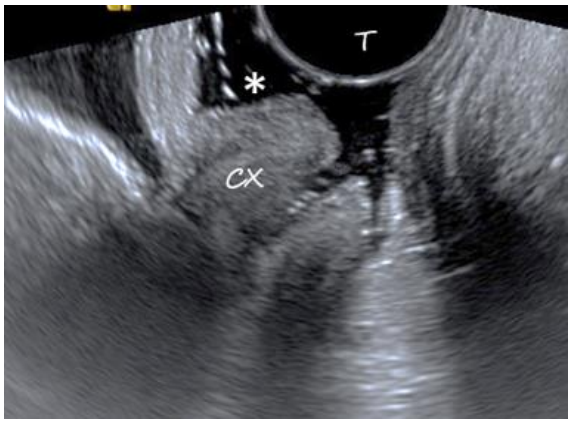
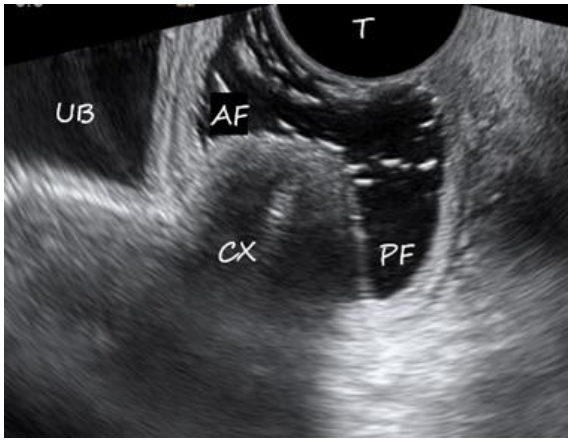


Figure 2: Normal anatomy of lower genital structures on gel sonovaginography (2A) depicts the endovaginal gel (asterisk) appearing anechoic with few hyperechoic foci suggestive of air bubbles. The gel is outlining the normal cervix (CX) delineating its anterior and posterior lips.

A standard transvaginal ultrasonography was performed on ACUSON S2000 ultrasound system (Siemens Medical Solutions) using EC9-4 probe in all cases to assess the uterus, adnexa, cervix, pouch of Douglas and vagina. Technique of filling the syringe [Figure 1A]: A new bottle of ultrasound gel is taken and held upside down using the left hand. A 20 ml syringe is held in the right hand and introduced into the bottle. The plunger is held steady in position using the thumb and ring finger and the outer barrel is slowly pushed up into the bottle of gel with the help of index finger to fill the syringe. Technique of gel instillation [Figure 1B]: Gel coated gloved index and middle fingers are inserted into the vagina which are then used to direct the gel filled syringe into the vagina. The ultrasound gel will then be instilled in the upper vagina/ posterior fornix of vagina. Then the syringe will be gently withdrawn. The transvaginal transducer will then be introduced into the vagina gently as to not displace the vaginal gel after which the lower genital tract structures will be examined by both gray scale and doppler ultrasound. Images of vaginal side walls, cervix, external os and pouch of Douglas obtained in multiple planes6 [Figure 2].

Any abnormality or mass lesions noted on grayscale ultrasound will be characterised based on their location, size and number of the lesion(s), shape, margins, echotexture and extent. Doppler examination is done to evaluate the vascularity of the lesions.

The findings will be correlated with clinical outcome in all the cases and with surgical, histopathological, colposcopic and MRI findings wherever possible.



Sagittal scan image (2B) shows the vaginal canal with visualization of anterior vaginal fornix (AF), the posterior vaginal fornix(PF) and the urinary bladder (UB) is seen anteriorly.

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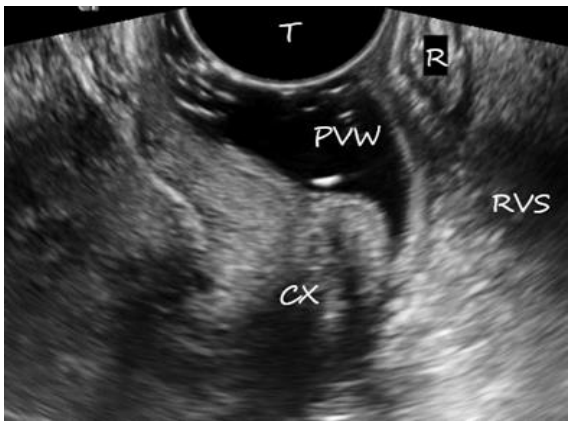

Sagittal scan image (2C) shows the posterior vaginal wall (PVW), rectum (R) and the intervening rectovaginal septum (RVS). (T= Transvaginal probe)

Statistical analysis was done after entering the data in MS Excel spreadsheet and using Statistical Package for Social Sciences (SSPS) version 25.0. Categorical variables were presented in numbers and percentages (%) and Continuous variables were presented as mean +/- SD and median with IQR. Qualitative variables were correlated using chi-square test / Fisher exact test.

RESULTS

The study included a total of 32 patients with cervical and vaginal lesions, comprising of 22 cervical lesions and 10 vaginal lesions [Table 1]. Among the 32 lesions, 22 were benign (68.7%) and 10 were malignant/ pre-malignant (31.2%).

Gel sonovaginography was able to detect the pathology in all patients who were incidentally found to have cervical or vaginal pathology on transvaginal ultrasound prior to clinical examination. In eight of our patients, the lesions were missed on transvaginal sonography. The diagnosis on GSV corresponded with the final diagnosis in all benign and malignant/pre-malignant cervical and vaginal cases.

The cervical lesions were well-delineated on GSV depicting their origin, margins and extension into proximal vagina [Table 2] due to better acoustic window and outline by the gel.

GSV was able to detect all the vaginal lesions whereas transvaginal sonography detected only 60% of the lesions [Table 3]. The origin, margins and involvement of the vaginal walls & fornices were detected well on GSV.

Correlation of the sonographic results were done with clinical, surgical, histopathological and MRI findings was done wherever possible [Table 4].

Table 1: Final distribution of pathologies (n=32).

Nature of lesion	Location	Final diagnosis	No.	%	Total
Benign	Cervical	Cervical polyp	5	15.6	13
		Cervical leiomyoma	3	9.3	
		Chronic cervicitis	4	12.5	
		Cervical hematoma	1	3.1	
	Vaginal	DIE	4	12.5	9
		Vaginal cyst	2	6.2	
		Vaginal leiomyoma	2	6.2	
		Benign vaginal polyp	1	3.1	
Pre- malignant/ Malignant	Cervical	Carcinoma cervix	8	25	9
		Cervical polyp	1	3.1	
	Vaginal	Vaginal vault carcinoma	1	3.1	1
Total			32	100	32

Table 2: Imaging features of cervical lesions on Gel sonovaginography (GSV) [n=22]

		Cervical polyp (n=6)	Cervical leiomyoma (n=3)	Chronic cervicitis (n=4)	Cervical hematoma (n=1)	Carcinoma cervix (n=8)
Origin/ location	Anterior lip	3	2	0	1	0
	Posterior lip	3	1	0	0	2
	Both	0	0	4	0	6
	Not made out	0	0	0	0	0
Size	< 5cm	6	2	4	1	4
	> 5cm	0	1	0	0	4
Margins seen	Yes	0	3	4	1	8
	No	6	0	0	0	0
Echogenicity	Hypoechoic	2	3	0	0	8
	Hyperechoic	4	0	2	0	0
	Anechoic	0	0	0	1	0
Vascularity	Present	6	3	0	0	8
	Absent	0	0	2	1	0
Extension into vagina	Present	0	1	0	0	4
	Absent	6	2	4	1	4

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Table 3: Imaging features of the vaginal lesions on Gel sonovaginography (GSV) [n=10]

		Deep Infiltrating Endometriosis (n= 4)	Vaginal Cyst (n=2)	Vaginal leiomyoma (n=2)	Benign vaginal polyp (n=1)	Vault carcinoma (n=1)
Origin/ location	Anterior wall	0	2	1	0	0
	Posterior wall	4	0	1	1	0
	Vault	0	0	0	0	1
	Not made out	0	0	0	1	0
Size	< 5cm	4	2	2	1	1
	> 5cm	0	0	0	0	0
Margins seen	Yes	4	2	2	1	1
	No	0	0	0	0	0
Echogenicity	Hypoechoic	4	0	2	1	1
	Hyperechoic	0	0	0	0	0
	Anechoic	0	2	0	0	0
Vascularity	Present	0	0	2	1	0
	Absent	4	2	0	0	0
Thickened vaginal fornix	Anterior	0	0	0	0	0
	Posterior	4	0	0	0	0
	Absent	0	2	2	1	0
	Could not be commented	0	0	0	0	1

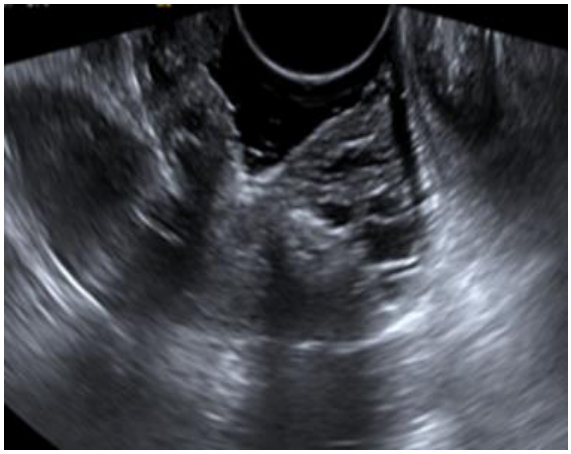
Table 4: Agreement of diagnosis on TVS and GSV with final diagnosis (n=32)

Diagnosis		No. of cases		
		TVS	GSV	Final Diagnosis
Benign lesions	Cervical	11	13	13
	Vaginal	5	9	9
Pre- malignant/ Malignant lesions	Cervical	7	9	9
	Vaginal	1	1	1
Normal study/ No diagnosis obtained		8	0	0

*Final diagnoses made on clinical/ surgical/ histopathological/ MRI/ Colposcopic correlation

DISCUSSION

Figure 3: 68 year old patient with Cervical polyp showing metaplasia. Standard transvaginal ultrasound sagittal image (3A) reveals an ill-defined heterogeneously hypoechoic lesion (arrow head) in the region of cervix with multiple anechoic cystic areas within.



Gel sonovaginography sagittal image (3B) shows the same lesion (arrow head) protruding into the proximal vaginal canal, better visualized due to the surrounding endovaginal gel (asterisk).

Cervical polyps: In our study, cervical polyps were the most commonly observed pathology, with six cases identified. While all the polyps were detected on TVS, the exact origin of three lesions could not be determined using this method. GSV on the other hand, provided much better localization as it clearly identified the origin of all six polyps, showing three arising from the anterior cervical lip and three from the posterior lip. GSV also offered a clearer view of the polyps' margins, their protrusion into the proximal vagina [Figure 3].

Clinical examination showed that the polyps were protruding through the external cervical os. Post

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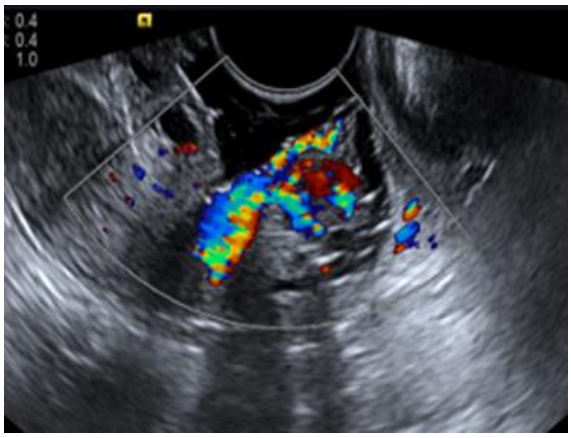
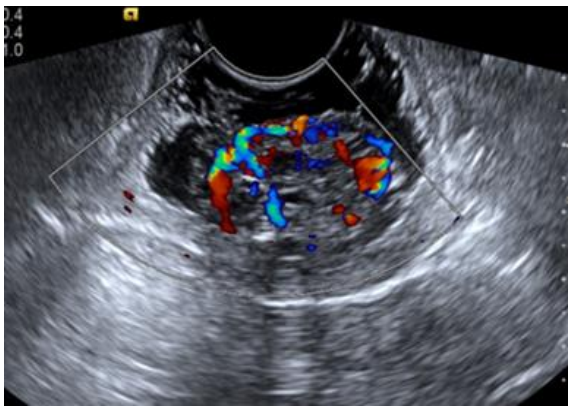
surgical histopathological analysis confirmed five as benign polyps and one with squamous metaplasia.



Color Doppler image (3C) shows significant internal vascularity within the lesion and a vascular stalk (arrow) is seen arising from endocervix.



Intralesional vascularity is seen (3D).

Cervical leiomyoma: Cervical leiomyomas are rare benign tumors of the cervix, as highlighted by Federico F et al. In our study, three cases of cervical leiomyomas were identified.

All leiomyomas were successfully visualized using both TVS and GSV [Table 2]. In these cases, there was no notable difference in the findings between both the modalities, suggesting that either modality can effectively identify and evaluate cervical leiomyomas of this nature.

Cervical Carcinoma: Our study identified eight cases of cervical carcinoma, with the primary complaint being vaginal bleeding, consistent with the findings of Hsiao Y et al.[8]

On TVS, six carcinoma lesions were visualized. However, the margins and their extension into the proximal vagina were not well-defined. All lesions showed marked vascularity on colour Doppler imaging, consistent with the findings of Alcazar L J et al,[1] who reported significant intra-tumoral vascularity in carcinoma of the cervix.

Extension into the proximal vagina and irregular margins were confirmed on GSV in all six cases [Figure 4]. Two additional small, irregular hyperechoic lesions in the posterior lip of the cervix, with increased vascularity, were detected only on GSV.

These findings were later corroborated clinically and by colposcopy with histopathology, confirming the accuracy of GSV in delineating cervical carcinoma.

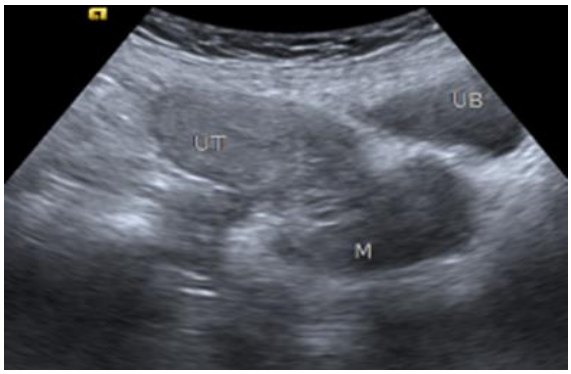
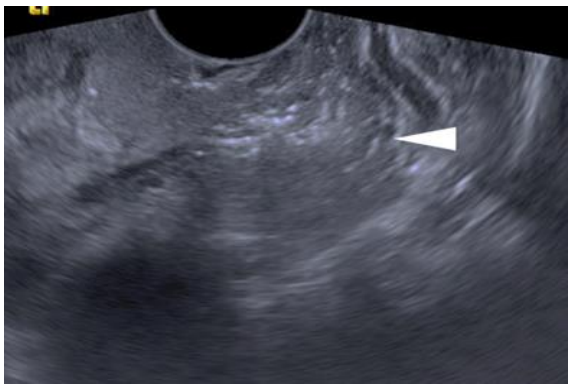
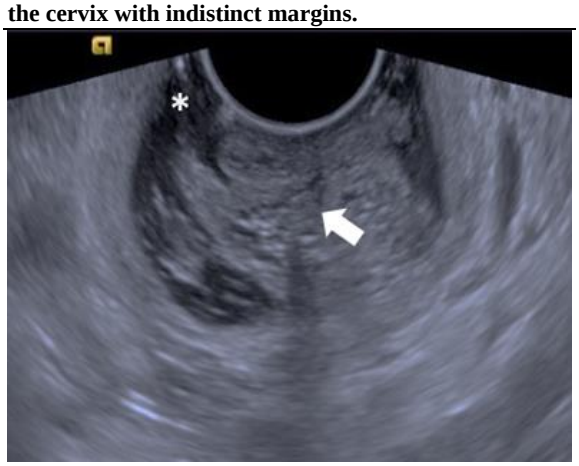


Fig 4: 40 year old patient with Carcinoma cervix. Transabdominal ultrasound sagittal image (4A) shows a large ill-defined heterogeneously hypoechoic mass (m) involving the cervix. Uterus (UT) and urinary bladder (UB) appear normal.



Transvaginal sonography sagittal image (4B) shows an ill-defined heterogeneously hypoechoic mass replacing the cervix with indistinct margins.



Gel sonovaginography axial (4C) shows the mass (arrows) with irregular margins and extension into the proximal vaginal canal well delineated by the surrounding endovaginal gel (asterisk).

Chronic cervicitis: There is a shortage of literature for imaging findings of cervicitis owing to the ease of its diagnosis and treatment based on clinical

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findings.[1] Our study included 4 patients with chronic cervicitis.

Both cases had nabothian cysts with bulky cervix which was easily picked up on TVS. However irregular cervical margins and minimal peripheral vascularity were appreciated well on GSV.

The patients showed cervical mucosal irregularity, flushing of the mucosa and presence of nabothian cysts (< 5cm) on clinical examination. The diagnosis was confirmed on histopathological examination as chronic cervicitis.

Cervical hematoma: We encountered a patient presenting with abnormal vaginal bleeding and a history of lower segment cesarean section. Clinical examination revealed a bulky, hyperemic cervix that was tender to touch, but no distinct lesion was identified.

On ultrasound, a well-defined, heterogeneously hypoechoic lesion was detected in the anterior lip of the cervix. The lesion showed no internal vascularity and did not extend beyond the cervix. Both transabdominal and transvaginal sonography revealed an associated endometrial collection. Additionally, TVS and GSV identified a communicating tract between the cervical hematoma and the endometrial collection. No significant difference in findings was observed between the two modalities in this case.

The sonographic findings were consistent with MRI results. Surgical drainage of the endometrial collection and cervical hematoma was performed.

Vaginal leiomyoma: Two cases of vaginal leiomyoma were seen in our study [Table 3]. The vaginal leiomyomas were seen as a well-defined heterogeneously hypoechoic lesions with smooth margins on TVS. However, its accurate localisation was not possible. On GSV, the lesions were seen arising from the posterior vaginal wall and protruding into the vaginal canal [Figure 5].

Surgical excision was done and histopathological examination confirmed the diagnosis.

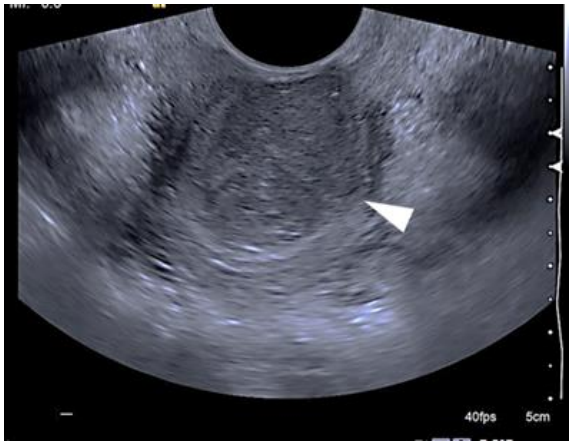
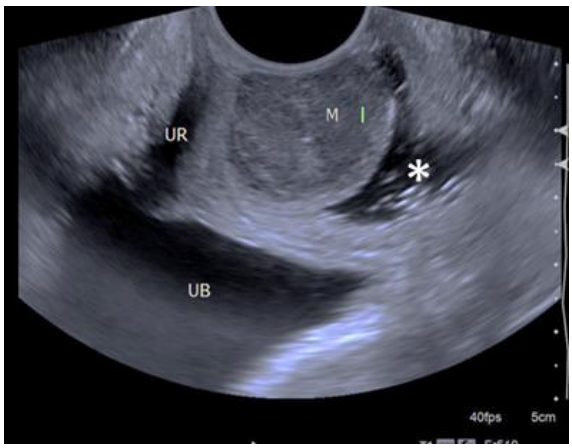
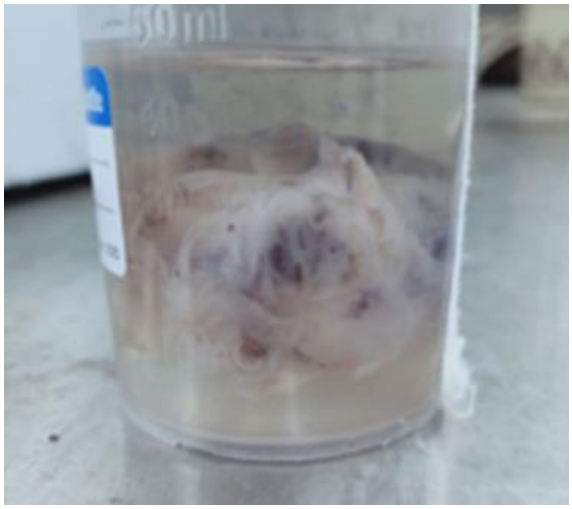


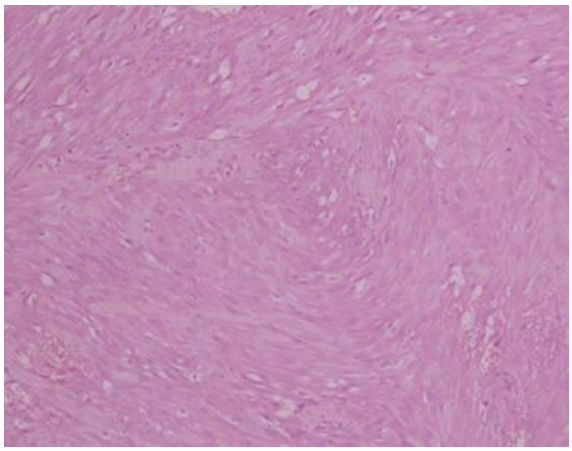
Figure 5: 24 year old patient with Vaginal leiomyoma. Standard transvaginal ultrasound axial image (5A) reveals a well-defined heterogeneously hypoechoic lesion (arrow head) filling the vaginal canal.



The gel sonovaginography sagittal image (5B) depicts the same mass (M) arising from the anterior vaginal wall and projecting into the vaginal canal with well-defined smooth margins showing maintained fat planes with the urinary bladder (UB) and urethra (UR) suggesting lack of involvement of the same. The lesion was diagnosed to be a vaginal leiomyoma.



Gross specimen of the lesion (5C) after myomectomy shows a white to tan colored non encapsulated mass.



Microscopic image (5D) shows smooth muscle cells in fascicles and bundles (Haematoxylin & eosin x 200x).

Vaginal cyst

Well-defined anechoic lesions were visualised in the vaginal canal on TVS. Exact origin of the lesions

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could not be made out on TVS. On GSV, the vaginal cysts were seen arising from the anterior vaginal wall and separated from the posterior vaginal wall by the inserted gel (Fig 6). The gel also helped in visualising the smooth cyst wall separately from the vaginal wall. Patients underwent surgery where marsupialisation of the lesions was done and serous fluid was drained.

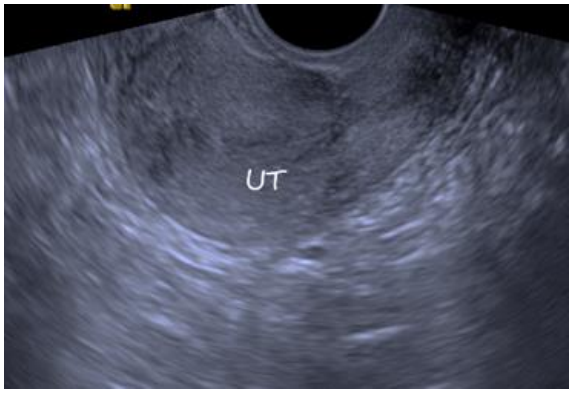
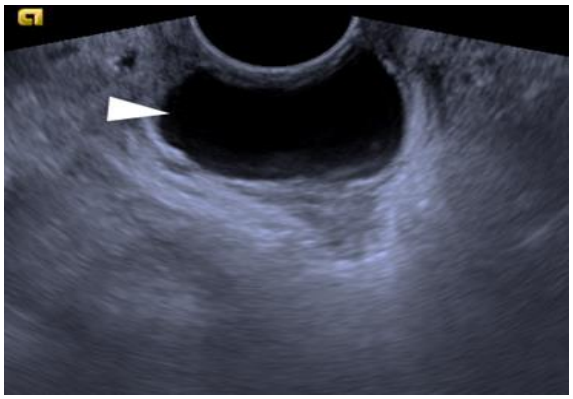
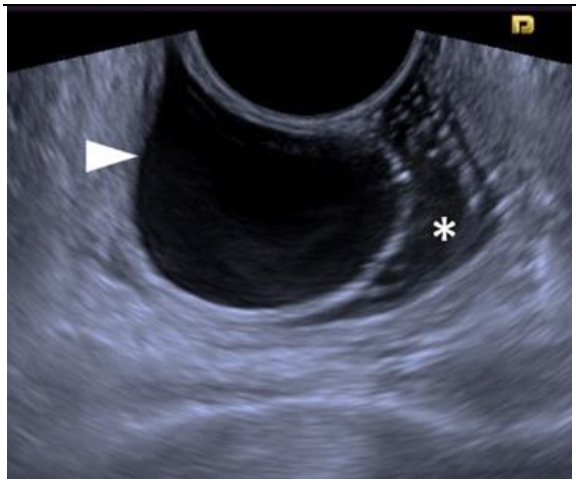


Figure 6: 40 year old patient with Vaginal cyst. Standard transvaginal ultrasound sagittal image (6A) shows normal uterus (UT) with thin & central endometrium.



Transvaginal ultrasound axial image (6B) reveals an anechoic cystic lesion (arrow head) within the vaginal canal showing inconspicuous margins with its origin not well discernible.



The gel sonovaginography sagittal image (6C) shows the same lesion (arrow head) with a thin wall and no internal septations or echoes, in the anterior vaginal wall and separated from the posterior vaginal wall by the gel (asterisk).

Vaginal vault carcinoma: Our study included one 55-year-old patient with a history of total abdominal hysterectomy 5 years back for cervical cancer who presented with pain abdomen and bleeding per vaginum on and off. An ill-defined hypoechoic lesion with vascularity was seen in the vaginal vault on TVS. GSV helped in the accurate delineation of its margins.

Clinical examination showed a hard and tender mass in the vaginal vault. The biopsy from the lesion showed squamous metaplasia of epithelium.

Deep infiltrating endometriosis: In our study, four cases of deep infiltrating endometriosis were not detected on TVS due to insufficient distension of the vaginal wall. The proximity of the probe to the fornices further limited visualization of the thickening in the posterior vaginal wall GSV provided clearer imaging, revealing ill-defined hypoechoic thickening of the posterior vaginal wall with central vascular foci [Figure 7]. Bratila E et al,[5] reported that abnormal hypoechoic linear thickening of the vaginal wall is suggestive of endometriosis. Additionally, reduced distensibility of the posterior fornix was noted in all four cases on GSV.

Our ultrasound findings were consistent with MRI results.

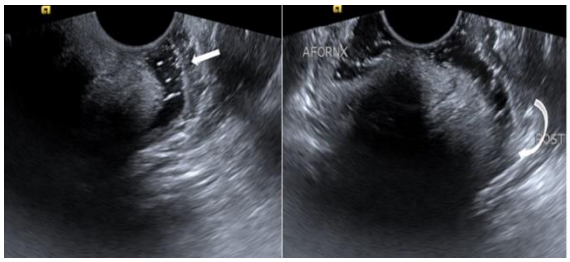
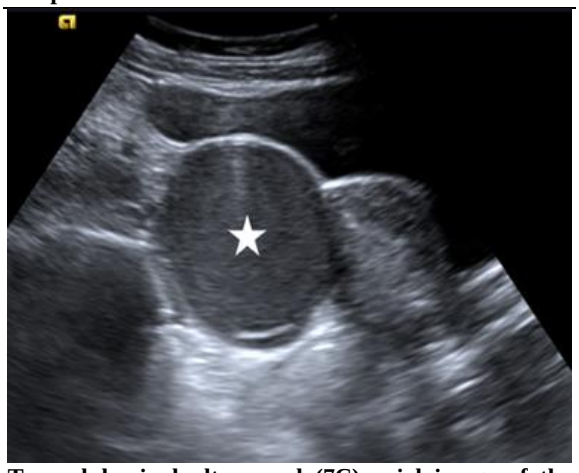


Fig 7: 32 year old female with Deep infiltrating endometriosis. Gel sonovaginography sagittal images (7A & 7B) show an ill-defined thickening involving the posterior vaginal wall (straight arrow) and reduced distensibility of the posterior fornix (curved arrow) as compared to anterior fornix.



Transabdominal ultrasound (7C) axial image of the same patient reveals an endometriotic cyst in the right ovary (star).

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Benign vaginal polyp: One patient with abnormal bleeding per vaginum was referred for ultrasound to our department.

No abnormality was detected in this case on TVS. On gel sonovaginography, a small, hypoechoic lesion arising from the anterior vaginal wall was detected. The lesion showed minimal vascularity on Doppler. Clinical examination showed a small polypoidal lesion in the anterior vaginal wall.

Comparative analysis of cervical lesions on TVS and GSV: GSV was better than TVS in characterisation of the cervical lesions in terms of localisation, delineating its margins and in assessing the extension of the lesions beyond the cervix. No difference between TVS and GSV was seen in lesion characterisation in cervical leiomyomas and cervical hematoma in our study.

Comparative analysis of vaginal lesions on TVS and GSV: Vaginal lesions were better characterised by GSV with accurate localisation and visualisation of lesion margins. Adequate distension of vagina was possible so as to visualise vaginal walls. This helped us detect the deep infiltrating endometriosis cases with ease.

CONCLUSION

Gel sonovaginography improves the detection, visualization and delineation of cervical and vaginal masses due to distension of the vagina by the introduced gel forming an acoustic window between the anatomical structures and/or lesions and the probe. Gel sonovaginography overcomes the limitations of transvaginal sonography.

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