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Intraoperative 3D Ultrasound Combined with Hysteroscopy for Decision-Guided Transcervical Surgery in Complex Intrauterine Pathology

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BACKGROUND & AIM

- Fast-track short-stay units leave little time for individualized preop planning.
- We integrated intraoperative 3D ultrasound with hysteroscopy for real-time anatomical assessment and surgical guidance.
- An incomparable advantage - simultaneous ultrasound and hysteroscopic assessment of hydrometra.

Objective

Evaluate 3D ultrasound + hysteroscopy for real-time, decision-guided transcervical surgery.

METHODS

- 612 women, from 19 to 46 years old (mean 35.3 ± 4.3)
- Short-stay unit, Jan–Mar 2025
- Mindray Resona i9 (2–9 MHz) + Karl Storz hysteroscope (operating tube with a diameter of 4 mm/5,5 mm), bipolar energy or 0.97 μm diode laser.
- All procedures were performed using an integrated hysteroscopic and intraoperative 2D/3D ultrasound workflow.



The integrated visual mini-operating room

PRINCIPLE OF OPERATION: simultaneous comprehensive assessment and expert-level surgical treatment

STANDARD HYSTEROSCOPY

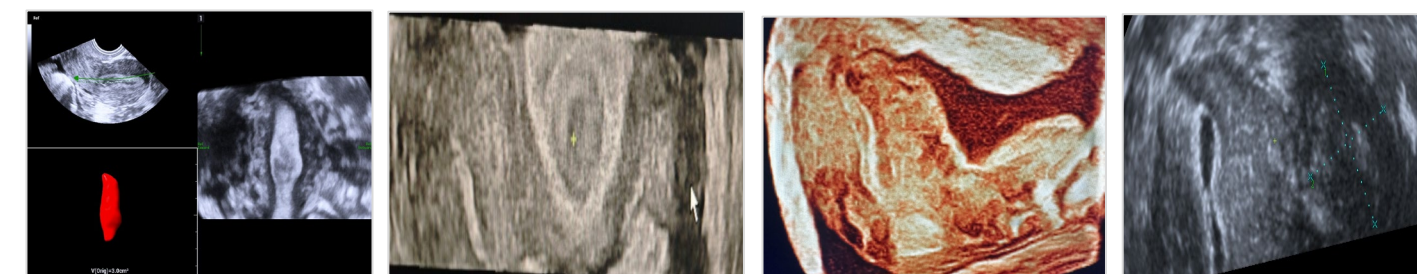
OFFICE HYSTEROSCOPY

SIMULTANEOUS DIFFERENTIAL DIAGNOSIS

Combined 2D/3D ultrasound + hysteroscopy - within a single hospitalization. Results obtained during the period from January to March 2025

MÜLLERIAN ANOMALIES (4.2%)

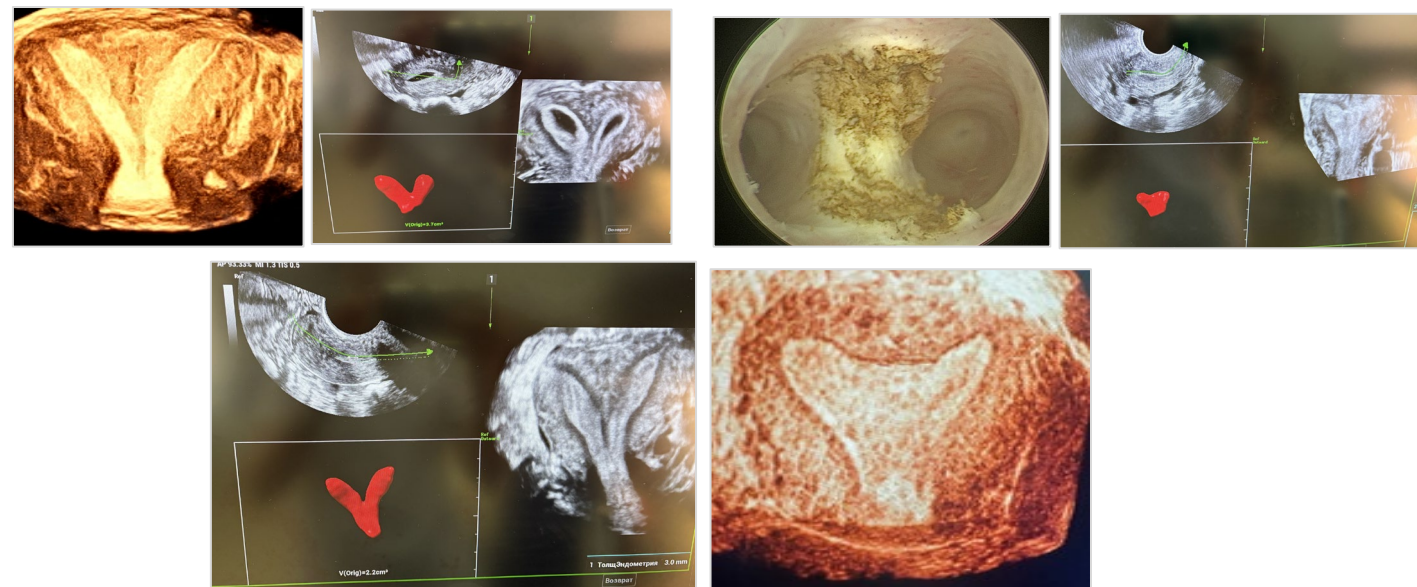
Unicornuate uterus: simultaneous verification of the anomaly, rudimentary horn (presence, function, communication with the main cavity), and patency of the main Fallopian tube



T-shaped uterus: diagnosis and monitoring of the safety and adequacy of laser correction



Intrauterine septum: diagnosis, choice of correction method (bipolar energy or diode laser energy), and monitoring the safety and adequacy of metroplasty



9/26 previously undiagnosed unicornuate uteri identified

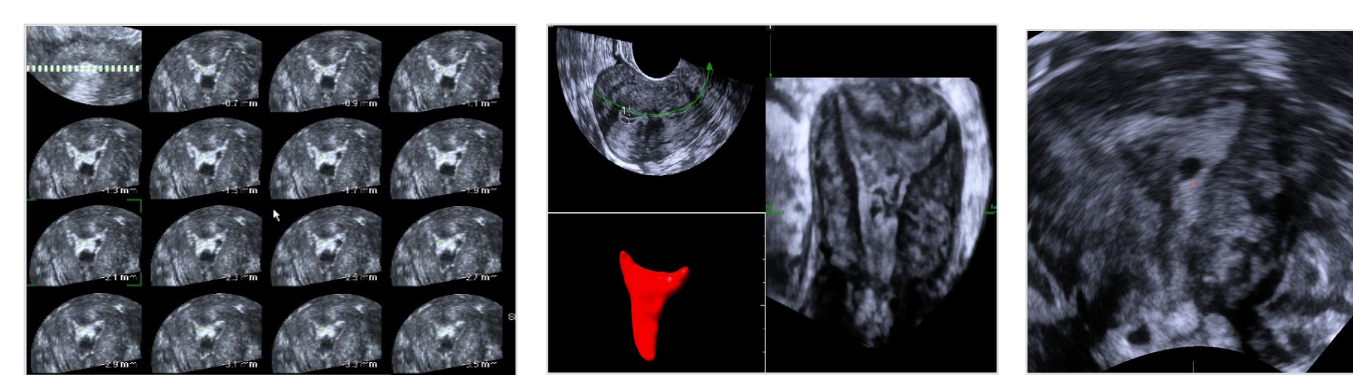
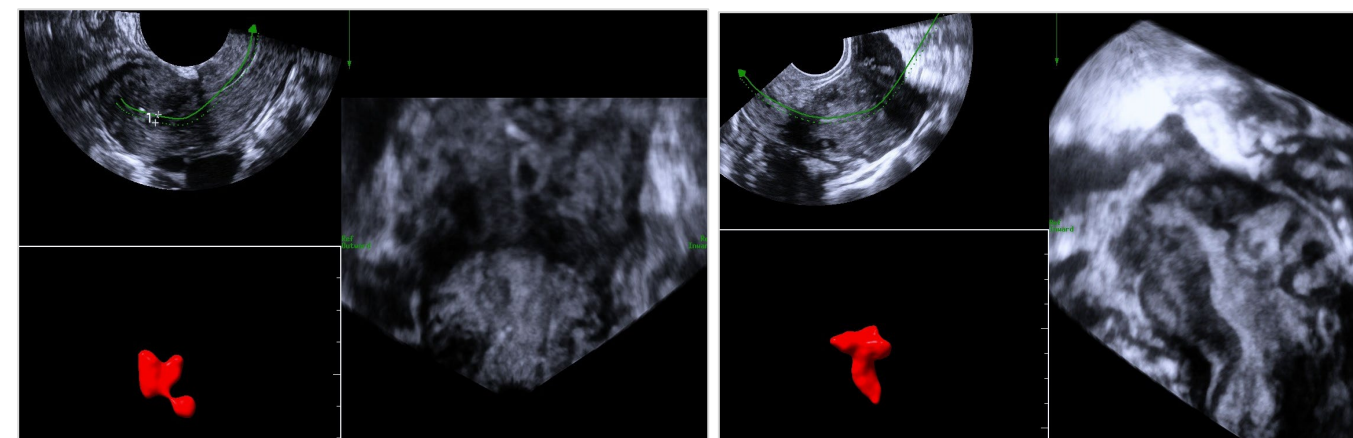
12/26 intrauterine septa

9/12 (75%) were diagnosed by 3D ultrasound in the integrated operating room

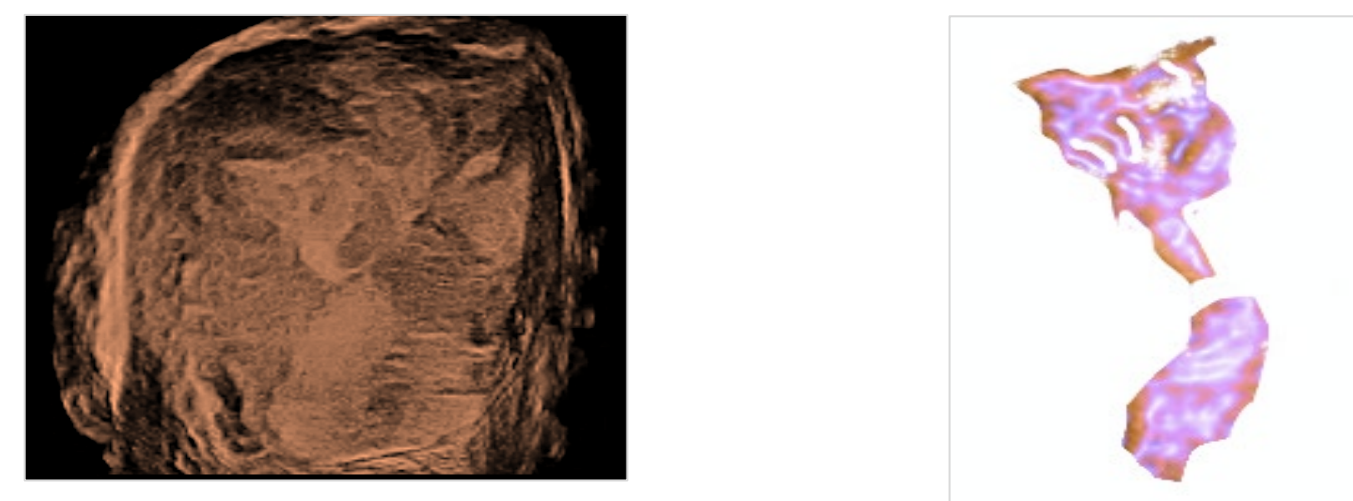
Septum correction was performed under intraoperative ultrasound guidance; laser metroplasty was used in 11/12 cases (91.7%)

INTRAUTERINE SYNECHIAE (6.2%)

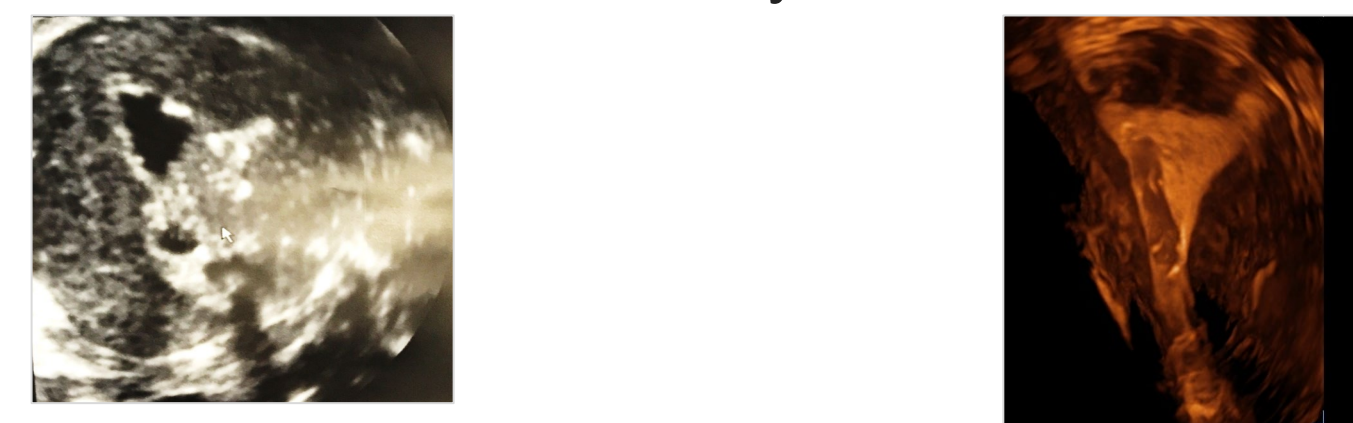
Detection of synechiae and assessment of the severity of intrauterine obliteration



Generation of a virtual cast and navigation map



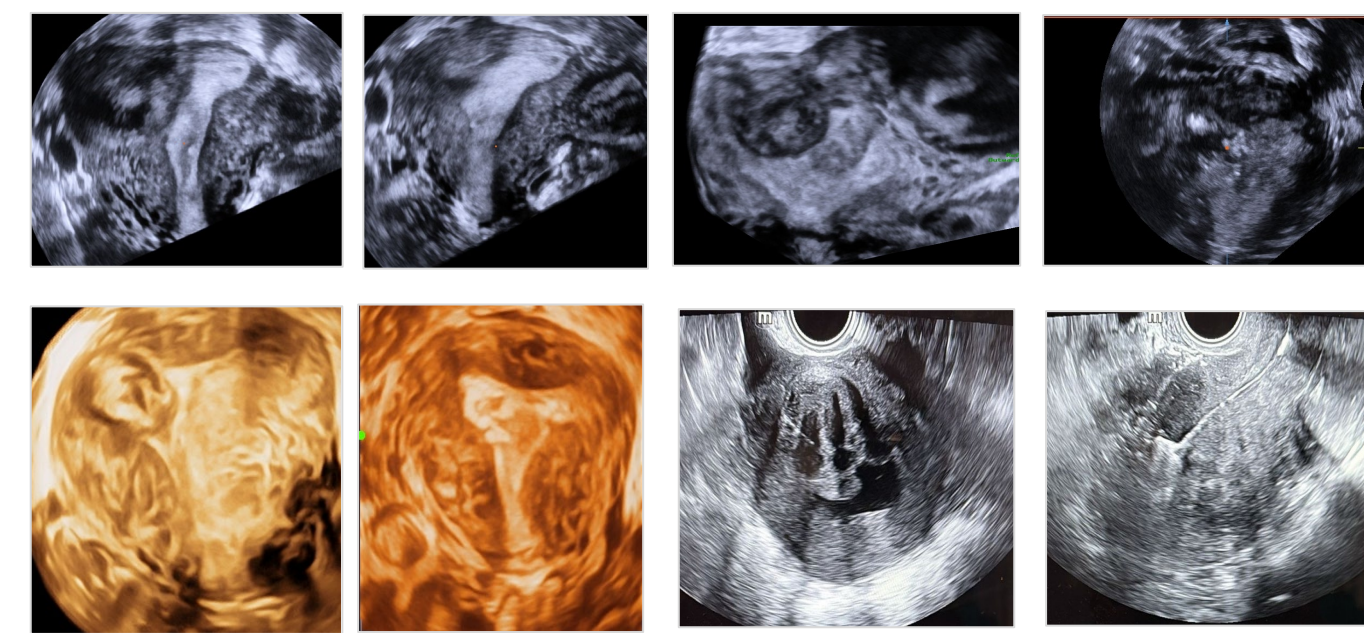
Monitoring the progress and safety of adhesiolysis



3D sonohysterography defined the extent of adhesions and the adhesiolysis pathway. Complete uterine cavity restoration: 38/38 (100%), no complications.

SUBMUCOSAL FIBROIDS (20.4%)

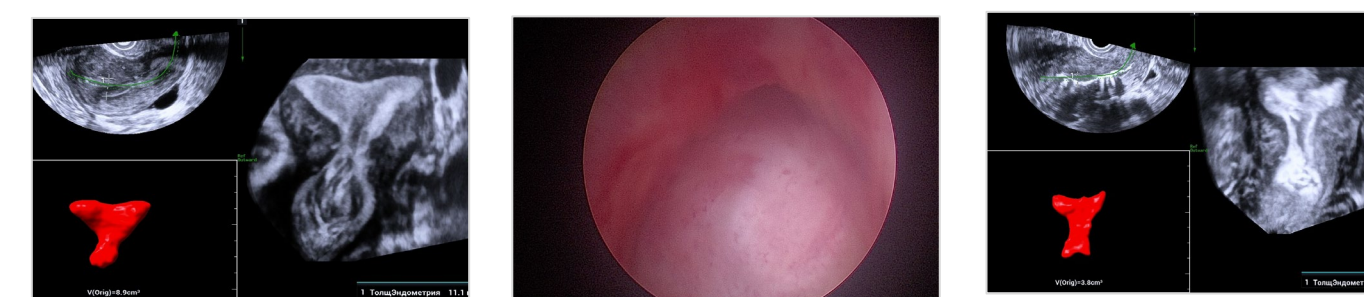
Residual myometrial thickness - the distance from the fibroid's lateral margin to the serosa - was used to assess resection complexity and guide safe myomectomy



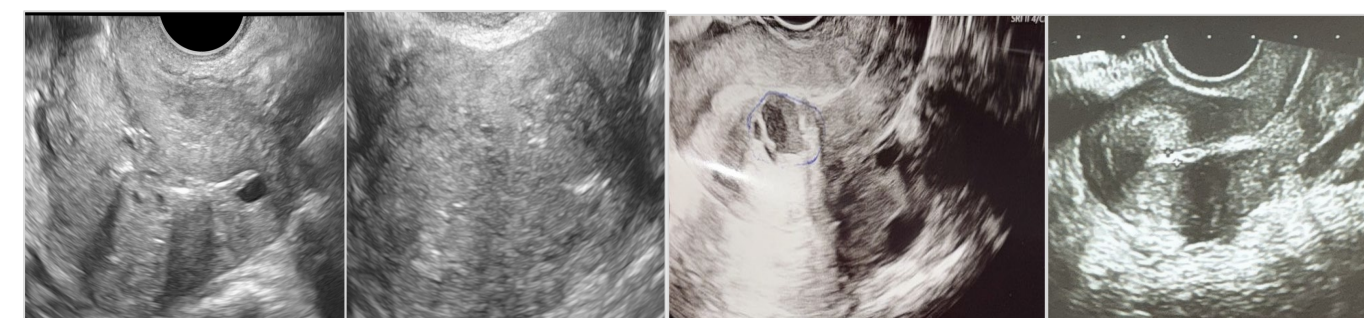
Selection of a myomectomy method (bipolar energy or diode laser energy for performing a safe intracapsular myomectomy)



Assistance in understanding the anatomy of atypical locations (cervical fibroids)



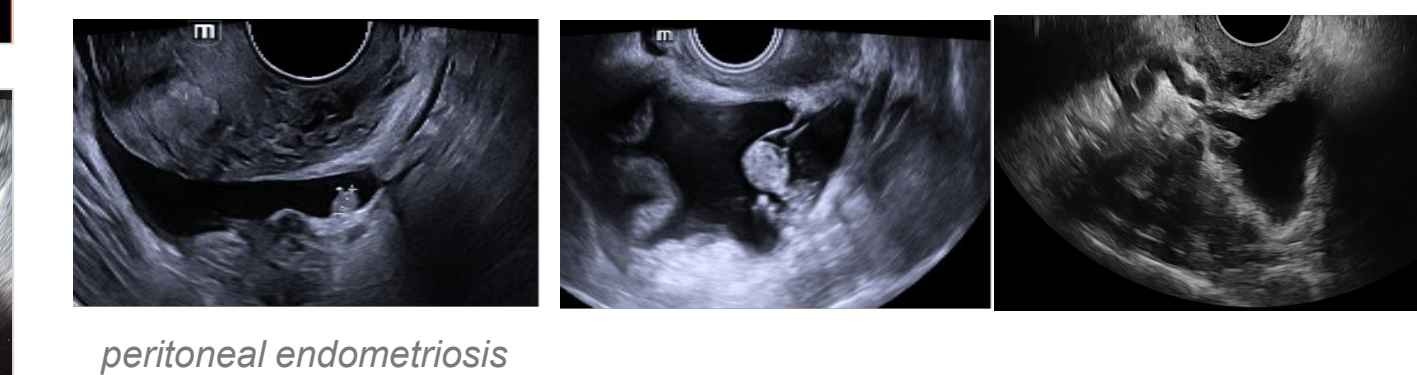
Diagnosis and removal of cystic or focal adenomyosis



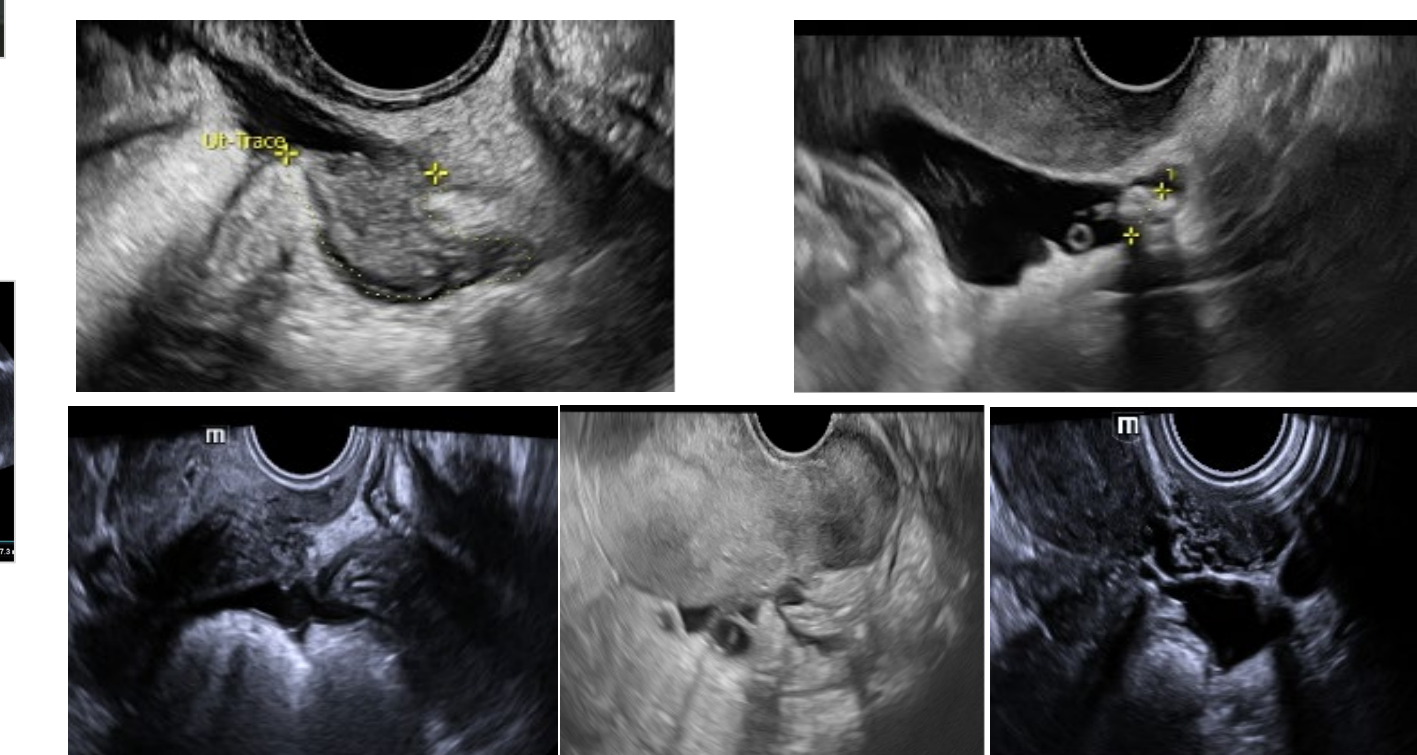
Submucosal fibroids removed by laser/bipolar myomectomy in all identified cases (20.4% of cohort), with residual myometrial thickness mapping guiding resection depth and adenomyosis nodes distinguished intraoperatively.

PERITONEAL & INFILTRATING ENDOMETRIOSIS (4%)

Peritoneal implants are the hardest endometriotic lesions to detect preoperatively - classically confirmed only by direct laparoscopic inspection. Intraoperative hydroperitoneum revealed heterotopias, septa and fibrosis on the peritoneal surface in real time.



Deep endometriosis - ranging from small foci to large conglomerates in the rectovaginal fascia, uterosacral ligaments or rectosigmoid - were ENZIAN-staged in real time, informing surgical planning without pausing for additional imaging



deep endometriosis

25/612 (4%) patients with peritoneal or deep infiltrating endometriosis

Multifocal bowel involvement in 3/25 (12%). Staged per the ENZIAN classification.

No additional investigations required - diagnosed within the same intraoperative session.

SIMULTANEOUS ASSESSMENT OF ALL INFERTILITY FACTORS

UTERINE FACTOR

Assessed simultaneously in all 612 patients via combined 3D-ultrasound and hysteroscopy - anomalies, synechiae, fibroids and endometrial pathology

TUBAL FACTOR

Tubal patency evaluated alongside uterine assessment: occlusion or hydrosalpinx identified in 7.2% of patients.

PERITONEAL FACTOR

Peritoneal and deep infiltrating forms diagnosed via hydroperitoneum sonography in the same session - no additional investigations needed

All three infertility factors evaluated within ONE hospitalization — no repeat procedures, no delayed diagnosis

SAFETY & EFFICIENCY

- Diagnosis + treatment in a single admission.
- Real-time ultrasound guidance improved surgical orientation and safety during transcervical surgery.

Conclusions

- 3DUS adds real-time anatomical information beyond hysteroscopy alone.
- Integrated imaging guides diagnosis, surgical navigation and assessment of procedural completeness.
- Complex pathology can be diagnosed and treated within a single short-stay admission.

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