

Effect of Uttarbasti Combined with Ayurvedic Oral Medicines in Women with PCOS Associated Anovulation and Thin Endometrium: A Case Series

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ABSTRACT

Polycystic Ovary Syndrome (PCOS) affects 8-13% women of reproductive age and is responsible for 80% cases of anovulatory infertility. The presence of thin endometrium (<7 mm) in PCOS patients is another challenging co-existing pathology along with anovulation to achieve implantation successfully. This case series included 13 patients aged 18-35 years with Rotterdam criteria-confirmed PCOS, Endometrial Thickness (EMT) <7 mm and anovulation. Management consisted of 3-months of oral Ayurvedic medicines and monthly Uttarbasti, followed by 3-month follow-up. Primary outcomes were ovulation, EMT ≥ 7 mm, and menstrual cycle regularisation. Secondary outcomes included conception rate. All 13 patients completed the treatment protocol. Promising improvements were noted in all primary outcomes from start to end point of treatment. The mean follicle grade increased from 0.00 ± 0.00 to 2.38 ± 1.04 ($p=0.001$, Wilcoxon signed-rank test), the mean EMT grade improved from 1.00 ± 0.00 to 2.23 ± 0.83 ($p=0.004$), and the mean menstrual regularity grade enhanced from 1.77 ± 0.73 to 0.54 ± 1.05 ($p=0.005$). After the end of the study 69.2% patients achieved ovulation, EMT improvement of ≥ 7 mm was attained by 76.9% patients, and menstrual cycles was regularised in 76.9% patients. No serious adverse events or treatment discontinuation occurred. The treatment protocol showed a satisfactory safety profile with minimal adverse effects with encouraging results in conception. This case series suggests that Uttarbasti with oral Ayurvedic medicines may improve ovulation, EMT, and menstrual cycle regularity in women with PCOS-associated anovulation and thin endometrium. Large scale randomised controlled trials are necessary to support these findings.

Keywords: *Asparagus racemosus*, Endometrial receptivity, Infertility, Ovulation induction, Polycystic Ovary Syndrome (PCOS), Reproductive medicine

INTRODUCTION

The PCOS is one of the most common endocrine disorders affecting women of reproductive age, with global prevalence ranging from 8% to 13% [1]. It is characterised by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology according to Rotterdam criteria, and is responsible for approximately 80% of anovulatory infertility cases [2]. The pathophysiology involves disturbed Hypothalamic-Pituitary-Ovarian (HPO) axis function, insulin resistance, and hormonal imbalances which collectively influence follicular maturation and ovulation [3].

In addition to anovulation, numerous patients with PCOS present with thin endometrium with thickness <7 mm during the mid-to-late follicular phase [4]. Adequate EMT is important for successful implantation and thickness ≥ 7 mm is considered as favourable for pregnancy outcomes [5]. The co-existence of anovulation and thin endometrium creates a dual barrier to conception that is rarely addressed in conventional treatment protocols [6].

Current management of PCOS-associated infertility primarily focuses on ovulation induction using medications such as clomiphene citrate, letrozole, and metformin [7]. However, these approaches often fail to adequately address endometrial receptivity, and some ovulation-induction agents may paradoxically reduce the EMT [8]. Various interventions for thin endometrium including estrogen supplementation, growth factors, Platelet-Rich Plasma (PRP), and intrauterine perfusion have shown variable success rates [9-11].

Ayurveda offers a holistic approach to reproductive disorders through herbal formulations, mineral preparations, and specialised procedures [12]. Uttarbasti, a Panchakarma procedure involving intrauterine administration of medicated oils or ghee, has been

used in Ayurvedic sciences for various gynecological conditions including infertility [13]. Classical Ayurvedic texts describe Uttarbasti as a therapy that nourishes the uterine tissue (Garbhashaya), clears obstruction in reproductive channels (Artava-Vaha Srotas), and promotes endometrial receptivity [14].

Shatavari (*Asparagus racemosus*), a key Ayurvedic herb, has recognised phytoestrogenic and anti-inflammatory properties [15] and Shatavari Ghrita may facilitate deep tissue penetration and sustained endometrial exposure to active compounds [16]. A recent case report on resistant anovulation described spontaneous ovulation and conception after an integrated Ayurvedic protocol that included Uttara Basti, suggesting a possible role for Uttara Basti in improving ovulatory and reproductive outcomes [17].

Although, several studies and case reports have suggested a possible role of Uttarbasti in improving EMT and fertility outcomes, systematic evidence in PCOS patients with concurrent thin endometrium remains limited [18,19]. Therefore, the present case series was undertaken to fill the knowledge gap and to document the potential efficacy and safety of Uttarbasti combined with oral Ayurvedic medications in women with PCOS-associated anovulation and concurrent thin endometrium, with respect to ovulation induction and improvement in EMT.

MATERIALS AND METHODS

The present case series was conducted at Mansarovar Ayurvedic Medical College, Hospital and Research Centre, Bhopal, Madhya Pradesh, India; a tertiary Ayurvedic teaching hospital from Jan 2024 to June 2025. The study protocol was approved by the Institutional Ethics Committee (IEC) (Letter number: 2023/94, Date of approval:

5th Oct 2023) and written informed consent was obtained. The study followed principles of the CARE (Case Report) guidelines for case series reporting [20].

Inclusion criteria:

- A. Women aged 18-35 years actively seeking conception.
- B. Confirmed PCOS diagnosis according to Rotterdam criteria (presence of ≥ 2 of 3 features):
 - a. Oligo/anovulation;
 - b. Hyperandrogenism (Clinical/biochemical);
 - c. Polycystic ovarian morphology on ultrasound [21].
- C. EMT < 7 mm measured by transvaginal ultrasonography (TVS) on day 10-16 of menstrual cycle [22];
- D. Documented anovulation on Trans Vaginal Sonography (TVS) ultrasound for last three consecutive cycles;
- E. Infertility;
- F. Menstrual irregularity, including oligomenorrhea or amenorrhea [21];
- G. Willingness to undergo Uttarbasti procedure and commit to 6-month follow-up.

Exclusion criteria:

- A. Age < 18 years or > 35 years;
- B. Thyroid dysfunction (TSH < 0.5 or > 5.0 mIU/L), hyperprolactinemia (prolactin > 25 ng/mL), or other known endocrinopathies;
- C. Uterine pathology (fibroids > 3 cm, Asherman's syndrome, congenital anomalies) or bilateral tubal occlusion confirmed by hysterosalpingography;
- D. Active pelvic inflammatory disease, cervicitis, or vaginal infection;
- E. Anticoagulant therapy or bleeding disorders;
- F. Previous Uttarbasti treatment within 6 months;
- G. Current pregnancy or lactation;
- H. Body Mass Index (BMI) > 35 kg/m²;
- I. Male factor infertility (partner's semen analysis showing severe oligospermia or azospermia).

Baseline assessment: All patients underwent comprehensive evaluation including:

Clinical assessment included detailed medical and gynecological history, menstrual pattern documentation, physical examination including BMI calculation and hirsutism assessment

Hormonal evaluation (on day 2 or 3 of cycle) included Follicle-Stimulating Hormone (FSH), Luteinising Hormone (LH), Prolactin, Thyroid-Stimulating Hormone (TSH).

Transvaginal ultrasonography (day 10-16) documenting Ovarian morphology and volume, Follicular development and EMT was done.

Ayurvedic Assessment included Prakriti (constitutional type) determination, Vikriti (current imbalance) assessment, Artava-Vaha Srotas (reproductive channel) evaluation, Agni (digestive fire) status

Therapeutic interventions:

Oral Ayurvedic Medications (3-month duration)

Madhumalini Vasant

- Main Compositions: Hingul (cinnabar), Yashada Bhasma (zinc compound), Kachora (*curcuma zedoaria*) and Maricha (*Piper nigrum*) [23];
- Dose: 250 mg twice daily after meals orally with warm water;
- Proposed mechanism: HPO axis stimulation, enhancement of oocyte maturation, hormonal balance restoration [24].

Gokshuradi Guggul:

- Main Compositions: Gokshura (*Tribulus terrestris*), Shuddha Guggulu (*Commiphora mukul*) [25];
- Dose: 500 mg twice daily after meals orally with warm water;
- Proposed mechanism: Kapha reduction, enhancement of follicular maturation, improvement of endometrial vascularity, insulin sensitivity modulation [26].

Vidarikand-Gokshur-Shatavari-Trikatu Ksheerapak:

- Dose: 40 mL once daily early morning on empty stomach orally [27]
- Preparation: Prepared by adding 10 gm herbal drugs (2 gm each of Vidarikand-Gokshur-Shatavari-Trikatu), 40 mL of fresh cow milk and 40 mL of water. The quantity will be reduced up to 40 mL that is equal to the milk taken before. Ksheerapaka will be filtered and transferred to a clean container and patients will be asked to consume it while it is lukewarm [28].

Proposed mechanism of Components:

- Vidarikand (*Pueraria tuberosa*): Nutritive, hormonal support
- Gokshur (*Tribulus terrestris*): Ovarian function enhancement
- Shatavari (*Asparagus racemosus*): Phytoestrogenic, endometrial support
- Trikatu (Ginger-Black pepper-Long pepper): Bioavailability enhancer, metabolic stimulant

Overall expected effect can be considered as tissue nourishment (Dhatu Poshana), digestive enhancement (Agni Deepana), endometrial growth support [29].

Uttarbasti with Shatavari Ghrita Schedule:

- Main Compositions: Shatavari (*Asparagus racemosus*) [30];
- Dose: 3 mL intrauterine instillation for three consecutive days from first to third month (after cessation of menses) [31];
- Procedure Protocol: The procedure was performed with the patient in the lithotomy position following vulval and perineal cleansing using an antiseptic solution. After speculum insertion and cervical cleaning with sterile gauze, warmed Shatavari Ghrita prepared in a sterile water bath. Using a sterile intrauterine insemination cannula, 3 mL of Shatavari Ghrita was slowly instilled into the uterine cavity over 1-2 minutes, after which the cannula was gently withdrawn. The patient was then maintained in a supine position for 15-30 minutes to facilitate optimal absorption and was counseled regarding possible mild spotting or cramping [31].
- Proposed mechanisms of Uttarbasti: The proposed mechanisms of Uttarbasti include the direct delivery of phytoestrogenic compounds to the endometrial tissue, promoting enhanced local blood flow and angiogenesis. Additionally, it exerts anti-inflammatory effects on the endometrium while providing nutritive support to Artava Dhatu (reproductive tissue), thereby facilitating optimal endometrial receptivity and uterine function [31].

Treatment for adverse events:

- Mild cramping/spotting: Hot fomentation and patient reassurance in view of future greater outcome than present milder pain or discomfort;
- If any severe complication other than above occurs due to the treatment protocol, the patient was managed accordingly and was excluded from the study.

Outcome assessment has been presented in [Table/Fig-1].

Primary outcomes:

- A. Ovulation restoration: Achievement of ovulation on transvaginal ultrasound (day 12-16);

Timepoint	Assessment	Purpose
Baseline (Day 0)	TVS + folliculometry + hormones	Establish baseline
Month 1	Folliculometry (day 10-16) + Endometrial Thickness (EMT)	Early response
Month 2	Folliculometry (day 10-16) + Endometrial Thickness (EMT)	Primary outcome assessment
Month 3	Folliculometry (day 10-16) + Endometrial Thickness (EMT)	Final treatment assessment
Months 4-6 (Follow up)	Folliculometry (day 10-16) + Endometrial Thickness (EMT)	Sustained effects, Secondary outcome assessment (conception)

[Table/Fig-1]: Follow-up assessment schedule.

- B. Endometrial Thickness (EMT) improvement: Achievement of EMT ≥ 7 mm on transvaginal ultrasound (day 10-16);
- C. Menstrual cycle regularisation: Achievement of regular cycles (28-35 days length) for ≥ 2 consecutive cycles.

Secondary outcomes:

- A. Conception rate: Biochemical pregnancy (β -hCG >25 mIU/mL) or clinical pregnancy (intrauterine gestational sac with cardiac activity) during follow-up till 6-month [32];

Patients were not followed until successful delivery because the study protocol was designed as a short-term case series focused on treatment response and early conception outcomes, with a fixed six-month follow-up window. Pregnancy continuation, obstetric complications, and live birth were therefore outside the scope of the present analysis.

Grading system:

To standardise outcome measurement, the following grading systems were employed:

Follicle size/ovulation grade:

- Grade 0: <12 mm (no dominant follicle, anovulation)
- Grade 1: 12-20 mm (developing follicle)
- Grade 2: >20 -24 mm (pre-ovulatory follicle)
- Grade 3: Evidence of ovulation (collapsed follicle/corpus luteum on ultrasound (33=19)

Endometrial Thickness (EMT) grade:

- Grade 0: <5 mm (severely thin)
- Grade 1: 5-7 mm (thin, suboptimal)
- Grade 2: >7 -9 mm (adequate)
- Grade 3: >9 mm (optimal) (19,33)

Menstrual frequency grade:

- Grade 0: Regular cycles (26-35 days)
- Grade 1: Irregular but <35 days
- Grade 2: Oligomenorrhea (36-90 days) [21]
- Grade 3: Amenorrhea (>90 days) [33]

STATISTICAL ANALYSIS

The primary outcomes were recorded as ordered grades, so they were compared before and after treatment using the Wilcoxon signed-rank test. Data were analysed using SPSS version 26.0 (IBM Corp., Armonk, NY) and Python statistical libraries. Descriptive statistics included frequencies and percentages for categorical variables, and mean $\pm$ standard deviation for continuous and ordinal variables. Normality of distribution was assessed using the Shapiro-Wilk test. Success rates for ovulation, EMT ≥ 7 mm, regular cycles and conception were calculated with 95% confidence intervals using Wilson score method [34]. Statistical significance was set at $p<0.05$ (two-tailed).

RESULTS

A total of 13 women meeting all inclusion criteria were enrolled between January 2024 and January 2025. All 13 patients (100%)

completed the 3-month active treatment protocol and 3-month follow-up period, which concluded in June 2025. No patient discontinued treatment due to adverse events or other reasons.

Baseline demographics and clinical characteristics:

The study cohort had a mean age of 28.4 ± 3.8 years, ranging from 22 to 35 years. The mean BMI was 26.8 ± 3.2 kg/m², with values ranging from 22.1 to 32.4 kg/m². The mean duration of infertility was 2.4 ± 1.1 years, with a range of 0.5 to 4.5 years. Of the 13 participants, nine women (69.2%) had primary infertility and four women (30.8%) had secondary infertility.

Baseline hormonal evaluation is summarised in [Table/Fig-2]. The mean LH level was 8.9 ± 0.5 IU/L and the mean FSH level was 5.6 ± 0.4 IU/L, with an average LH/FSH ratio of 1.6 ± 0.1 . Mean prolactin and TSH levels were 16.0 ± 3.2 ng/mL and 3.0 ± 0.6 mIU/mL, respectively. There was no abnormality in the study participants, except that BMI was above the normal range in all participants except in three cases [Table/Fig-3]. This baseline profile was consistent with PCOS-associated anovulation without overt hyperprolactinaemia or thyroid dysfunction.

Parameter	Mean $\pm$ SD	Median (IQR)	Laboratory reference range (adult women)
LH (mIU/mL)	8.9 $\pm$ 0.5	8.8 (8.6-9.2)	2.4-12.6 mIU/mL (follicular)
FSH (mIU/mL)	5.6 $\pm$ 0.4	5.6 (5.3-5.9)	1.4-9.9 mIU/mL (follicular)
LH/FSH ratio	1.6 $\pm$ 0.1	1.6 (1.5-1.6)	0.5-2.0
Prolactin (ng/mL)	16.0 $\pm$ 3.2	15.7 (13.4-18.9)	4.79-23.3 ng/mL
TSH (μ IU/mL)	3.0 $\pm$ 0.6	2.9 (2.5-3.4)	0.54-5.3 mIU/mL

[Table/Fig-2]: Baseline hormonal profile of study participants.

Patient level data table						
Case	Age	BMI	Baseline EMT	EMT after treatment	Ovulation after treatment	Pregnancy
1	25	25.6	Grade 1	Grade 3	Grade 3/Ovulated	-
2	35	28	Grade 1	Grade 1	Grade 1	-
3	27	23.5	Grade 1	Grade 3	Grade 3/Ovulated	Conceived
4	32	28.6	Grade 1	Grade 2	Grade 2	-
5	22	27.2	Grade 1	Grade 2	Grade 3/Ovulated	-
6	33	26	Grade 1	Grade 3	Grade 3/Ovulated	Conceived
7	26	29.4	Grade 1	Grade 2	Grade 3/Ovulated	-
8	28	22.1	Grade 1	Grade 3	Grade 3/Ovulated	Conceived
9	27	30.1	Grade 1	Grade 1	Grade 0	-
10	30	24.8	Grade 1	Grade 3	Grade 3/Ovulated	-
11	34	32.4	Grade 1	Grade 1	Grade 1	-
12	29	26.5	Grade 1	Grade 3	Grade 3 / Ovulated	Conceived
13	31	26.7	Grade 1	Grade 2	Grade 3/Ovulated	-

[Table/Fig-3]: Patient level data table.

At baseline, all 13 (100%) patients presented with anovulation (Grade 0 follicle size) and thin endometrium (Grade 1, thickness 5-7 mm). The majority (69.2%, n=9) had oligomenorrhea, while 1 (7.7%) patient had amenorrhea, and only 1 (7.7%) patient had relatively regular cycles. Mean baseline EMT was 5.8 ± 0.6 mm (range 5.0-6.8 mm) [Table/Fig-4].

Primary Outcomes

All three primary outcomes showed significant improvements from baseline to post treatment assessment (month 3) [Table/Fig-5]. The primary outcome table reports baseline versus month three results because month three was the active-treatment endpoint; month six data were collected for follow-up assessment of sustained response and conception

Ovulation restoration: Ovulation restoration showed a promising improvement after treatment. The mean follicle size/ovulation

Parameter	Grade/Category	n (%)
Follicle size	Grade 0 (<12 mm)	13 (100.0%)
	Grade 1 (12-20 mm)	0
	Grade 2 (>20-24 mm)	0
	Grade 3 (Ovulated)	0
Endometrial Thickness (EMT)	Grade 0 (<5 mm)	0
	Grade 1 (5-7 mm)	13 (100.0%)
	Grade 2 (7-9 mm)	0
	Grade 3 (>9 mm)	0
Menstrual frequency	Grade 0 (Regular)	1 (7.7%)
	Grade 1 (Irregular)	2 (15.4%)
	Grade 2 (Oligomenorrhea)	9 (69.2%)
	Grade 3 (Amenorrhea)	1 (7.7%)

[Table/Fig-4]: Baseline characteristics of study participants (N=13).

Outcome	Baseline	Post treatment (3 months)	Change	p-value
Ovulation (grade)	0.00±0.00	2.38±1.04	+2.38	0.001
EMT (grade)	1.00±0.00	2.23±0.83	+1.23	0.004
Menstrual Reg. (grade)	1.77±0.73	0.54±1.05	-1.23*	0.005

[Table/Fig-5]: Primary outcome measures: baseline vs post treatment (Month 3).

*Lower grade indicates improvement for menstrual regularity.
Menstrual regularity grade (Menstrual Reg)

grade increased from 0.00±0.00 at baseline to 2.38±1.04 post treatment, which was statistically significant (p=0.001). Overall, 9 of 13 patients (69.2%, 95% CI: 42.4-87.3%) achieved documented ovulation, confirmed by ultrasound evidence of corpus luteum. The response also showed a progressive temporal pattern, with 20% of patients ovulating by month 1, 50% by month 2, and 69.2% by month 3.

Endometrial Thickness (EMT) improvement: EMT also showed improvement after treatment. The mean EMT grade increased from 1.00±0.00 at baseline, when all patients were in Grade 1 (5-7 mm), to 2.23±0.83 after treatment, and this change was statistically significant (p=0.004). Overall, 10 of 13 patients (76.9%, 95% CI: 49.7-91.8%) achieved an EMT of at least 7 mm. In terms of absolute thickness grade, the mean value increased from 5.8±0.6 mm to 8.3±1.4 mm, representing a 43% relative improvement. By month three, the distribution had shifted further, with seven patients (53.8%) in Grade 2 (7-9 mm), 3 patients (23.1%) in Grade 3 (>9 mm), and only three patients (23.1%) remaining in Grade 1 (5-7 mm).

Menstrual cycle regularisation: Menstrual cycle regularisation also showed improvement after treatment. The mean menstrual frequency grade decreased from 1.77±0.73 to 0.54±1.05, and this change was statistically significant (p=0.005), with a lower grade indicating better regularity. In addition, 10 of 13 patients (76.9%, 95% CI: 49.7–91.8%) achieved regular menstrual cycles of 28-35 days for at least two consecutive cycles.

Secondary Outcomes

Conception (secondary outcome): Conception was achieved in four out of 13 patients (30.8%, 95% CI: 12.7-57.6%) during the 3-month follow-up period from months four to six. Two patients conceived in month four, one in month five, and one in month six, and all four pregnancies occurred spontaneously without the need for assisted reproductive treatment. Notably, all conceptions were observed in patients who had achieved both ovulation and an EMT of at least seven mm during active treatment. At the time of study conclusion, three pregnancies were ongoing, while one resulted in an early pregnancy loss at seven weeks. Among the nine patients who did not conceive, treatment effects appeared to persist in some

cases, with three of nine (33.3%) continuing to ovulate at follow-up month three, seven of nine (77.8%) maintaining an EMT of at least seven mm, and four of nine (44.4%) retaining regular menstrual cycles [Table/Fig-6].

Secondary outcome	n/N	Rate (%)	95% CI	Notes
Conception	4/13	30.8	(12.7, 57.6)	Till 3-month follow-up
Sustained ovulation*	3/9	33.3	(11.8, 64.6)	At follow-up month 3
Maintained EMT ≥7 mm*	7/9	77.8	(45.3, 93.7)	At follow-up month 3
Sustained regular cycles*	4/9	44.4	(18.9, 73.3)	At follow-up month 3

[Table/Fig-6]: Secondary outcomes during follow-up period.

*Among non pregnant patients (n=9) at follow-up month 3 cases

Safety and Tolerability

The treatment protocol demonstrated favourable short-term safety and tolerability in this small cohort [Table/Fig-7].

Adverse event	n (%)	Timing/ description	Management	Outcome
Transient lower abdominal pain/cramping	5 (38.5%)	During or shortly after Uttarbasti	Reassurance; observation	Resolved spontaneously within 2-4 hours
Light vaginal spotting	3 (23.1%)	After Uttarbasti; lasted 1-2 days	No medical intervention required	Resolved spontaneously
Pelvic infection	0 (0%)	Not observed	–	–
Uterine perforation	0 (0%)	Not observed	–	–
Allergic reaction	0 (0%)	Not observed	–	–
Treatment discontinuation due to adverse events	0 (0%)	Not observed	–	–

[Table/Fig-7]: Adverse events.

Adverse events: In a few patients mild adverse events were reported. Five patients (38.5%) complained of transient lower abdominal pain or cramping during or shortly after the Uttarbasti procedure, which resolved spontaneously within two-four hours. Three patients (23.1%) experienced light vaginal spotting for one–two days after the Uttarbasti procedure, which required no medical intervention.

Serious adverse events: No serious adverse events were observed during the study. None of the patients had serious adverse effects such as pelvic infection, uterine perforation, or allergic reactions.

Treatment Discontinuation: Zero patients discontinued treatment (0%)

Predictors of Treatment Response

Ovulation rates were higher among patients with a BMI <28 kg/ m² (80.0% vs. 57.1%, p=0.28), and those with Vata-Pitta Prakruti showed a trend toward better ovulatory response (75.0% vs. 62.5%, p=0.54). Patients with a baseline EMT of 6-7 mm showed higher achievement rates compared to those with 5-5.9 mm (87.5% vs. 62.5%, p=0.22). Improvement in EMT displayed no significant association with age, BMI, or infertility duration. All four conceptions occurred in patients who achieved both ovulation and an EMT ≥ 7 mm during treatment. Spontaneous conception occurred in patients who had a lower mean age (26.8±2.9 years) and shorter infertility duration (1.6±0.7 years) compared to non conceiving participants (29.1±4.0 years mean age and 2.8±1.1 years infertility duration, respectively; p=0.27 and p=0.06). Because the sample size was small, the results should be seen as preliminary trends which will prove to be helpful for generating future research hypotheses.

DISCUSSION

This case series proves that the combination of Uttarbasti (intrauterine Shatavari Ghrita administration) along with oral Ayurvedic medicines may be effective in inducing ovulation, improving EMT, and regularising menstrual cycle in women with PCOS and co existing thin endometrium. The interventional treatment protocol achieved ovulation induction in 69.2%, adequate EMT in 76.9%, and menstrual cycle regularisation in 76.9% of patients and spontaneous conception in 30.8% patients during follow-up with a satisfactory safety profile. The apparent difference between the rates of menstrual regularisation and ultrasound-confirmed ovulation can be justified as: cycle regularisation may be considered a preliminary marker of endocrine recovery, with ovulation potentially occurring in subsequent cycles if treatment is continued beyond three months; nevertheless, regular menstruation alone does not reliably establish ovulation [35].

Although the observed outcomes fall within ranges reported in some conventional treatment studies, direct comparison is not appropriate because of differences in study design, patient characteristics, and sample size. A randomised controlled trial by Legro RS et al., reports ovulation rates of 70-80% with letrozole and 60-75% with clomiphene citrate in PCOS [7]. Some conventional drugs may adversely affect endometrial development; clomiphene citrate can reduce EMT due to its anti-estrogenic effects and up to 15-30% of ovulatory cycles show EMT <7 mm [8].

The overall effect of our treatment protocol on ovulation induction can be explained as recent Ayurvedic literature suggests that selected interventions may support female reproductive health and hormonal balance, with proposed relevance to the HPO axis [24]. *Tribulus terrestris* has been reported to have beneficial effects on the female reproductive system, and review-level evidence suggests possible improvement in ovarian and uterine histology in PCOS; in the present study, its use was considered as a potential supportive component for ovulatory and endometrial response rather than as a proven standalone mechanism [26]. Guggul-related compounds have demonstrated antidiabetic activity in experimental models, including improved glucose tolerance, suggesting a potential role in insulin sensitisation and metabolic regulation [36]. The gradual and slow improvement in ovulation induction in monthly TVS ultrasound is suggestive of the overall effect of the intervention which is consistent with basic Ayurvedic principles of gradual tissue restoration (Dhatu Poshana).

The enhancement in EMT in 76.9% of patients from baseline thin endometrium to ≥ 7 mm is encouraging and appears broadly similar to improvements reported with several existing interventions, although definitive comparisons cannot be made in this case-series design. A systematic review by Wang Y et al., (2024) reported success rates ranging from 30% to 70% depending on intervention type [6]. Oestrogen supplementation has been reported to improve endometrial development in thin endometrium and may support pregnancy outcomes, although response varies [37]. Recent advancements such as PRP infusion show promising but mixed results in EMT and pregnancy rates [38]. A meta-analysis by Chang Y et al., found that PRP infusion increased EMT by 1.8-2.2 mm with pregnancy rates of 25-40% [39]. In our study the average EMT increased by 2.5 mm (43% improvement). Numerically consistent with newer emerging intrauterine modalities.

Few Ayurvedic case studies and pilot studies have explored the results of Uttarbasti for gynecological conditions. Shukla Upadhyay K et al., reported 73.3% relief in tubal blockage with Kumari Taila Uttarbasti and 60% conception rate [40]. Also, some studies indicate that Uttarbasti has possible endometrial receptivity improvement effects, but most of the published evidence are single case reports or small uncontrolled case series [17,40]. The present study adds design in a well-defined dual pathology population (PCOS with thin

endometrium) using standardised ultrasound outcomes and formal statistical analysis.

The encouraging findings observed in this case series are likely to be resulted due to overall combined therapeutic hypothesised mechanisms of all treatment modalities which acted upon multiple pathophysiological components:

The findings may reflect combined systemic and local mechanisms of the oral formulations and Uttarbasti. Systemically, Madhumalini Vasant and related formulations may modulate the HPO axis, support follicular maturation, and improve metabolic and hormonal balance, consistent with Vishya and Rasayana properties described in Ayurvedic texts [24]. *Tribulus terrestris* [26,41] and *Commiphora mukul* [42] have been reported to exert insulin-sensitising and anti-inflammatory effects that could contribute to improved ovulatory function. Shatavari and Vidarikand contain phytoestrogenic saponins that may gently support oestrogen receptor activity and endometrial growth [15,27].

Locally, Uttarbasti bypasses the first-pass metabolism and achieves high local concentrations of the drug [28]. Intrauterine administration of Shatavari Ghrita delivers phytoestrogenic [15] and anti-inflammatory constituents directly to the endometrium, potentially enhancing blood flow, angiogenesis, and tissue nourishment [43]. The procedure may also provide mild mechanical stimulation of the endometrium, analogous to endometrial injury, which has been reported to improve implantation or pregnancy outcomes in selected infertile women, although findings are not uniform across all populations [44]. The lipophilic nature of medicated ghee may prolong tissue exposure to bioactive compounds. These mechanisms remain hypotheses and require dedicated mechanistic studies.

This protocol may be beneficial especially for PCOS patients with dual pathologies of anovulation and thin endometrium, where only conventional ovulation induction may be insufficient. The treatment could be explored as an integrative option or, in future trials, as an adjunct before assisted reproduction when conventional medicines are poorly tolerated or fail to optimise EMT. In this series, only mild, transient adverse events were observed; suggesting acceptable short-term tolerability, but long-term safety, formulation standardisation, and practitioner training need further evaluation before routine clinical use.

In this small population the conception rate of 30.8% during the 3-month follow-up is encouraging, especially given that ovulation induction in PCOS is successful in about 70-80% of women and cumulative pregnancy rates of 70-75% have been reported over 6-9 treatment cycles [45]. The sustained ovulation and adequate EMT in some patients during follow-up suggest potential for lasting physiological correction rather than temporary hormonal manipulation. This aligns with Ayurvedic concepts of Dosha Samya (balance restoration) and Dhatu Samyata (tissue equilibrium) as treatment goals [46]. The partial sustainability in ovulation and regularisation of cycles indicates that some patients may require maintenance therapy or periodic treatment courses.

The absence of serious adverse events and zero discontinuations, with only mild transient events in a minority of patients, is encouraging, although the small sample and short follow-up limit conclusions about long-term safety. The intrauterine procedure of Uttarbasti has theoretical complications such as infection, uterine perforation, and bleeding. However, our careful protocol with sterile technique, appropriate patient selection, and trained administration likely minimised these risks. The mild cramping and spotting observed in some patients resolved spontaneously and are consistent with expected responses to intrauterine procedures. Contraindications to Uttarbasti are mentioned in the classical Ayurvedic texts which include pregnancy, and our exclusion of uterine anomalies, likely contributing to the safety outcomes [14].

Strengths of the study include its prospective design, clearly defined inclusion-exclusion criteria, standard primary-secondary outcomes,

focus on specific dual pathology (anovulation with thin endometrium) and fair assessment using TVS and parameter wise grading. Appropriate statistical analysis with non parametric tests, confidence intervals and p-values. The integration of modern clinical outcomes with Ayurvedic concepts and intervention provides a useful framework for evaluating traditional therapies in reproductive medicine.

Limitation(s)

However, several limitations must be acknowledged. The uncontrolled case-series design with a small sample size cannot prove a definite cause-and-effect relationship, and improvements may partly reflect placebo effects or natural variation. The open-label, single-centre design without blinding introduces potential selection and observer bias, and the simultaneous administration of multiple interventions prevents attribution of effects to individual components, including the independent contribution of Uttarbasti versus oral medicines. The follow-up period was relatively short and did not extend to live-birth outcomes, so long-term efficacy, sustainability, and obstetric safety remains uncertain. Narrow eligibility criteria and possible lifestyle changes during the study limit generalisability, and mechanistic interpretations are speculative in the absence of biomarker or tissue-level data.

Future research should include multicentric randomised controlled trials comparing Ayurvedic protocol with standard ovulation induction treatments, with live-birth and long-term safety as primary outcomes. Mechanistic studies examining endometrial histology, biomarkers, hormonal profiles, and molecular signalling could clarify pathways of action. Work on formulation standardisation, procedure training, and cost-effectiveness will be essential for implementation. Such studies may confirm, refine, or refute the preliminary signals observed here and better define the role of Uttarbasti-based protocols in managing PCOS-associated anovulation with thin endometrium.

CONCLUSION(S)

This open-label interventional case series suggests that Uttarbasti with oral Ayurvedic formulations may be associated with improvements in ovulation, EMT, and menstrual cycle regularisation in women with PCOS-associated anovulation and thin endometrium. In this small cohort, 69.2% of patients achieved documented ovulation, 76.9% attained EMT ≥ 7 mm, and 30.8% conceived spontaneously during short-term follow-up, with only mild transient adverse events and no serious complications observed. These findings indicate that the studied protocol may offer a potentially useful integrative option for managing this challenging dual pathology, but they should be regarded as preliminary because of the uncontrolled design and limited sample size. Larger, adequately powered randomised controlled trials with live-birth outcomes are required to confirm these observations and to clarify the independent contribution of Uttarbasti and oral medications.

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REFERENCES

- [1] Bozdogan G, Mumusoglu S, Zengin D, Karabulut E, Yildiz BO. The prevalence and phenotypic features of polycystic ovary syndrome: A systematic review and meta-analysis. *Hum Reprod*. 2016;31(12):2841-55. Doi: 10.1093/humrep/dew218. Epub 2016 Sep 22. PMID: 27664216.
- [2] Joham AE, Norman RJ, Stener-Victorin E, Legro RS, Franks S, Moran LJ, et al. Polycystic ovary syndrome. *Lancet Diabetes Endocrinol*. 2022;10(9):668-80. Doi: 10.1016/S2213-8587(22)00163-2. Epub 2022 Aug 4. Erratum in: *Lancet Diabetes Endocrinol*. 2022;10(11):e11. Doi: 10.1016/S2213-8587(22)00281-9. PMID: 35934017.
- [3] Dumesic DA, Oberfield SE, Stener-Victorin E, Marshall JC, Laven JS, Legro RS. Scientific statement on the diagnostic criteria, epidemiology, pathophysiology, and molecular genetics of polycystic ovary syndrome. *Endocr Rev*. 2015;36(5):487-525. Doi: 10.1210/er.2015-1018. PMID: 26426951; PMCID: PMC4591526.
- [4] Zhao J, Zhang Q, Wang Y, Li Y. Endometrial pattern, thickness and growth in predicting pregnancy outcome following 3319 IVF cycle. *Reprod Biomed Online*. 2014;29(3):291-98. Doi: 10.1016/j.rbmo.2014.05.011.
- [5] Ribeiro VC, Santos-Ribeiro S, De Munck N, Drakopoulos P, Polyzos NP, Schutyser V, et al. Should we continue to measure endometrial thickness in modern-day medicine? The effect on live birth rates and birth weight. *Reprod Biomed Online*. 2018;36(4):416-26. Doi: 10.1016/j.rbmo.2017.12.016. Epub 2018 Jan 3. PMID: 29361452.
- [6] Wang Y, Tang Z, Teng X. New advances in the treatment of thin endometrium. *Front Endocrinol (Lausanne)*. 2024;15:1269382. Doi: 10.3389/fendo.2024.1269382. PMID: 38745960; PMCID: PMC11092375.
- [7] Legro RS, Brzyski RG, Diamond MP, Coutifaris C, Schlaff WD, Casson P, et al.; NICHD Reproductive Medicine Network. Letrozole versus clomiphene for infertility in the polycystic ovary syndrome. *N Engl J Med*. 2014;371(2):119-29. Doi: 10.1056/NEJMoa1313517. Erratum in: *N Engl J Med*. 2014;317(15):1465. PMID: 25006718; PMCID: PMC4175743.
- [8] Dehbashi S, Parsanezhad ME, Alborzi S, Zarei A. Effect of clomiphene citrate on endometrium thickness and echogenic patterns. *Int J Gynaecol Obstet*. 2003;80(1):49-53. Doi: 10.1016/s0020-7292(02)00341-7. PMID: 12527460.
- [9] Keng F, Ling W, Zhao Z, Yudi L, Xiang L, Derong L, et al. Network meta-analysis on the efficacy of different interventions for treating thin endometrium. *Front Endocrinol (Lausanne)*. 2025;16:1575248. Doi: 10.3389/fendo.2025.1575248. PMID: 40909225; PMCID: PMC12406221.
- [10] Gleicher N, Kim A, Michaeli T, Lee HJ, Shohat-Tal A, Lazzaroni E, et al. A pilot cohort study of granulocyte colony-stimulating factor in the treatment of unresponsive thin endometrium resistant to standard therapies. *Hum Reprod*. 2013;28(1):172-77. Doi: 10.1093/humrep/des370. Epub 2012 Oct 18. PMID: 23081869.
- [11] Molina A, Sánchez J, Sánchez W, Vielma V. Platelet-rich plasma as an adjuvant in the endometrial preparation of patients with refractory endometrium. *JBRA Assist Reprod*. 2018;22(1):42-48. Doi: 10.5935/1518-0557.20180009. PMID: 29303234; PMCID: PMC5844658.
- [12] Rathil I, Mavi A, Shannawaz M, Saeed S, Yadav A, Hasan S. Effectiveness of ayurveda intervention in the management of infertility: A systematic review. *Cureus*. 2024;16(4):e57730. Doi: 10.7759/cureus.57730. PMID: 38711705; PMCID: PMC11073818.
- [13] Acharya YT, editor. *Sushruta Samhita of Sushruta with Nibandhasangraha Commentary of Dalhanacharya*. Varanasi: Chaukhambha Orientalia; 2014. Chikitsasthana 37/96-99.
- [14] Tripathi B, editor. *Charaka Samhita of Agnivesha: Elaborated Vidyotini Hindi Commentary*. Varanasi: Chaukhambha Surbharati Prakashan; 2011. Siddhasthana 9/62-67.
- [15] Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Plant profile, phytochemistry and pharmacology of *Asparagus racemosus* (Shatavari): A review. *Asian Pac J Trop Dis*. 2013;3(3):242-51. Doi: 10.1016/S2222-1808(13)60049-3. PMID: PMC4027291.
- [16] Goyal RK, Singh J, Lal H. *Asparagus racemosus*—an update. *Indian J Med Sci*. 2003;57(9):408-14. PMID: 14514255.
- [17] Jadhao VP, Shrivastava P. Management of resistant anovulation with Uttara Basti therapy: A case report. *J Clin Diagn Res*. 2026;20(6):JD04-JD07. Doi: 10.7860/JCDR/2026/87905.23512.
- [18] Lamoria S, Adalinge SA, Meher K, Meher S. Effect of Uttar Basti on Endometrial Thickness and Ovulation in Women with Thin Endometrium. *IRJAY*. [online] 2025;8(7):64-68. Available from: <https://irjay.com> Doi link- <https://doi.org/10.47223/IRJAY.2025.80713>.
- [19] Adhav V, Adhav P, Akulwar A, Lamture Y, Kadvane SG. An open randomized clinical trial of Rasona Taila Uttarbasti And Rasona Sidhha Kshirpan in infertility W.S.R. to anovulatory cycle. ECS - The Electrochemical Society. 2022;107(1). Doi: 10.1149/10701.18339ecst.
- [20] Gagnier JJ, Kienle G, Altman DG, Moher D, Sox H, Riley D; CARE Group. The CARE guidelines: Consensus-based clinical case reporting guideline development. *Headache*. 2013;53(10):1541-47. Doi: 10.1111/head.12246. PMID: 24266334.
- [21] Rotterdam ESHRE/ASRM-Sponsored PCOS consensus workshop group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). *Hum Reprod*. 2004;19(1):41-47. Doi: 10.1093/humrep/deh098. PMID: 14688154.
- [22] Mahajan N, Sharma S. The endometrium in assisted reproductive technology: How thin is thin? *J Hum Reprod Sci*. 2016;9(1):03-08. Doi: 10.4103/0974-1208.178632. PMID: 27110071; PMCID: PMC4817285.
- [23] Jadhav S, V A, S M. Preliminary physicochemical evaluation of madhumalini vasant ras tablet – an ayurveda herbo-mineral formulation. *IJAM [Internet]*. 2024;15(2):370-74. Available from: <https://ijam.co.in/index.php/ijam/article/view/4367>.
- [24] Mishra A, Pillai D. Role of Ayurveda in Improving Female Reproductive Health and Hormonal Balance. *Kaumarbhritiya: Journal of Ayurvedic Pediatrics and Child Health*. 2026;1(1):38-48. Available from: <https://admin.mantechpublications.com/index.php/KBJAPCH/article/download/3839/2429>.
- [25] Patel V, Gupta SN, Patel M, Kalsariya B. Physicochemical & phytochemical evaluation of gokshuradi guggulu - an ayurvedic herbal formulation. *International Journal of Applied Ayurved Research*. 2017;3(3):672-76.
- [26] Ghanbari A, Akshai N, Nedaei SE, Mollica A, Aneva IY, Qi Y, et al. Tribulus terrestris and female reproductive system health: A comprehensive review. *Phytomedicine*. 2021;84:153462. Doi: 10.1016/j.phymed.2021.153462. Epub 2021 Jan 8. PMID: 33602600.
- [27] Sharangadhara. *Sharangadhara Samhita*. Pandita Parashuram Shastri Vidyasagar, editor. Varanasi: Chaukhambha Surbharati Prakashana; 2013. Madhyama Khanda, 2nd Adhyaya, Shloka 3. p. 99.

- [28] Rajeshwara Dutta Shastri, Ambika Dutta Shastri. Bhaishajya Ratnavali. 14th edition, Chaukambha Sanskrit Samsthana, Varanasi, 2001, Chapter Gulmaroga/13.
- [29] Pandey AK, Gupta A, Tiwari M, Prasad S, Pandey AN, Yadav PK, et al. Impact of stress on female reproductive health disorders: Possible beneficial effects of shatavari (*Asparagus racemosus*). *Biomed Pharmacother*. 2018;103:46-49. Doi: 10.1016/j.biopha.2018.04.003. Epub 2018 Apr 7. PMID: 29635127.
- [30] Mishra SN. Bhaishajya Ratnavali. Chaukhamba Surbharati Prakashan; 2009. Chapter 13, verses 132–137, p. 400.
- [31] Verma A, Dhiman K, Kumar S. a clinical study on Uttar Basti of Bhrihat Shatavari Ghrita and Baladi Churna in the management of female infertility w.s.r. to endometrial receptivity. *Journal of Ayurveda and Integrated Medical Sciences*. 2017;2(1):7-14. Doi: 10.21760/jaims.v2i1.7480.
- [32] Yadid IM, Criscuolo TS, Santos JF, Giordano LA. Can biochemical pregnancy be determined 5 days after frozen-thawed embryo transfer? *JBRA Assist Reprod*. 2022;26(1):62-67. Doi: 10.5935/1518-0557.20210054. PMID: 34415123; PMCID: PMC8769177.
- [33] Jacob J, Vijayakumar N, Olickal JJ. Effect of satapushpa churnam with tila tailam in oligomenorrhea associated with polycystic ovarian syndrome. *J Ayurveda Integr Med*. 2021 Oct;12(4):695-99. Doi: 10.1016/j.jaim.2021.06.015. Epub 2021 Nov 2. PMID: 34740494; PMCID: PMC8642696.
- [34] Wilson EB. Probable inference, the law of succession, and statistical inference. *J Am Stat Assoc*. 1927;22(158):209-12. Doi: 10.1080/01621459.1927.10502953.
- [35] Panidis D, Tziomalos K, Chatzis P, Papadakis E, Delkos D, Tsourdi EA, et al. Association between menstrual cycle irregularities and endocrine and metabolic characteristics of the polycystic ovary syndrome. *Eur J Endocrinol*. 2013;168(2):145-52. Doi: 10.1530/EJE-12-0655. PMID: 23109645.
- [36] Cornick CL, Strongitharm BH, Sassano G, Rawlins C, Mayes AE, Joseph AN, et al. Identification of a novel agonist of peroxisome proliferator-activated receptors alpha and gamma that may contribute to the anti-diabetic activity of guggulipid in *Lep(ob)/Lep(ob)* mice. *J Nutr Biochem*. 2009;20(10):806-15. Doi: 10.1016/j.jnutbio.2008.07.010. Epub 2008 Oct 15. PMID: 18926687.
- [37] Vartanyan E, Tsaturova K, Devyatova E. Thin endometrium problem in IVF programs. *Gynecol Endocrinol*. 2020;36(sup1):24-27. Doi: 10.1080/09513590.2020.1816724. PMID: 33305667.
- [38] Özyurt R, Bulutlar E, Yılmaz MB. Autologous platelet-rich plasma intrauterine perfusion improves the fertility outcome by correcting the thin endometrium due to clomiphene citrate. *Medical Journal of Bakırköy*. 2024;20:72-78. Doi: 10.4274/BMJ.galenos.2024.2023.10-3
- [39] Chang Y, Li J, Wei LN, Pang J, Chen J, Liang X. Autologous platelet-rich plasma infusion improves clinical pregnancy rate in frozen embryo transfer cycles for women with thin endometrium. *Medicine (Baltimore)*. 2019;98(3):e14062. Doi: 10.1097/MD.00000000000014062. PMID: 30653117; PMCID: PMC6370111.
- [40] Shukla Upadhyay K, Karunagoda K, Sata N, Dei LP. Effect of Kumari Taila Uttar Basti on fallopian tube blockage. *Ayu*. 2010;31(4):424-29. Doi: 10.4103/0974-8520.82031. PMID: 22048533; PMCID: PMC3202247.
- [41] Li M, Qu W, Wang Y, Wan H, Tian C. Hypoglycemic effect of saponin from *Tribulus terrestris*. *Zhong Yao Cai*. 2002;25(6):420-22. Chinese. PMID: 12583337.
- [42] Sharma JN, Sharma JN. Comparison of the anti-inflammatory activity of *Commiphora mukul* (an indigenous drug) with those of phenylbutazone and ibuprofen in experimental arthritis induced by mycobacterial adjuvant. *Arzneimittelforschung*. 1977;27(7):1455-57. PMID: 578471.
- [43] Sharma PV. *Dravyaguna Vijnana (Vegetable Drugs)*. Vol 2. Varanasi: Chaukhamba Bharati Academy; 2006.
- [44] Metwally M, Chatters R, Pye C, Dimairo M, White D, Walters S, et al. Endometrial scratch to increase live birth rates in women undergoing first-time in vitro fertilisation: RCT and systematic review. *Health Technol Assess*. 2022;26(10):1-212. Doi: 10.3310/JN2T9406. PMID: 35129113; PMCID: PMC8859770.
- [45] Balen AH, Braat DD, West C, Patel A, Jacobs HS. Cumulative conception and live birth rates after the treatment of anovulatory infertility: Safety and efficacy of ovulation induction in 200 patients. *Hum Reprod*. 1994;9(8):1563-70. Doi: 10.1093/oxfordjournals.humrep.a138750. PMID: 7989523.
- [46] Lad V. *Textbook of Ayurveda: Fundamental Principles*. Albuquerque, NM: Ayurvedic Press; 2002.

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