Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/c3zg9b47

EFFECTIVENESS OF THERMAL BALLOON ENDOMETRIAL ABLATION IN THE MANAGEMENT OF ABNORMAL UTERINE BLEEDING UNRESPONSIVE TO MEDICAL THERAPY: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Abnormal uterine bleeding (AUB) is a prevalent gynecological condition that significantly impairs quality of life, particularly among perimenopausal women. While medical therapy is the first-line treatment, a substantial proportion of women fail to achieve adequate symptom control and require minimally invasive alternatives. Thermal balloon endometrial ablation (TBEA) has emerged as a safe and effective uterus-preserving option for such cases.

Objectives: To evaluate the clinical efficacy, hematological improvement, and safety profile of thermal balloon endometrial ablation in women with AUB refractory to medical management.

Methods: This prospective observational study included 30 women aged 35–50 years with AUB persisting despite at least six months of medical therapy. Baseline assessments included PBAC scoring, pelvic examination, Pap smear, endometrial biopsy, ultrasound evaluation, and hemoglobin estimation. All participants underwent TBEA under anesthesia. Follow-up was conducted at 10 days, 1 month, and 3 months, assessing menstrual outcomes, PBAC score, endometrial thickness, hemoglobin level, and postoperative complications.

Results: The mean pre-treatment PBAC score significantly reduced from 740.0 ± 108.8 to 142.8 ± 189.6 at three months, corresponding to an 80.7% reduction ($p < 0.001$). Endometrial thickness decreased from 9.24 ± 1.26 mm to 5.55 ± 0.47 mm, a 40% reduction ($p < 0.001$). Hemoglobin levels showed a significant improvement from 9.43 ± 1.13 g/dL to 9.87 ± 0.76 g/dL ($p = 0.027$). No major intraoperative or postoperative complications were observed, and patient satisfaction was high at follow-up.

Conclusion: Thermal balloon endometrial ablation is a highly effective and safe treatment modality for AUB refractory to medical therapy. It offers substantial reduction in menstrual blood loss, normalization of endometrial thickness, improvement in hemoglobin levels, and excellent patient satisfaction. TBEA represents a valuable minimally invasive alternative to hysterectomy, particularly in resource-limited settings.

KEYWORDS: Abnormal uterine bleeding; Thermal balloon endometrial ablation; Endometrial thickness; PBAC score; Minimally invasive gynecology; Refractory AUB; Menorrhagia.

INTRODUCTION

Abnormal uterine bleeding (AUB) is one of the most common gynecological complaints affecting women in the reproductive and perimenopausal age groups, contributing significantly to poor quality of life, anemia, and healthcare burden worldwide. The global prevalence of AUB ranges from 15% to 30% among reproductive-aged women, with higher rates reported in perimenopausal women due to anovulatory cycles and endometrial dysfunction [1]. The FIGO PALM–COEIN classification has standardized the etiological framework for AUB, categorizing it into structural and non-structural causes, thus improving diagnostic accuracy and therapeutic decision-making [2].

Medical therapy—including NSAIDs, tranexamic acid, combined oral contraceptives, and levonorgestrel intrauterine systems—remains the first-line approach. However, up to 52% of women either fail or discontinue medical treatment due to inadequate symptom control or side effects [3]. Traditionally, hysterectomy has been the definitive treatment for refractory AUB, but it is associated with higher surgical morbidity, longer recovery time, and increased healthcare costs. Therefore, minimally invasive alternatives that preserve the uterus have gained relevance in modern gynecologic practice [4].

Endometrial ablation techniques aim to destroy the functional endometrium, offering a less invasive option for women who have completed childbearing. Second-generation ablation modalities, such as thermal balloon endometrial ablation (TBEA), have become increasingly favored due to shorter learning curves, reduced operative time, fewer complications, and high patient satisfaction rates [5]. TBEA uses a heated fluid-filled balloon to uniformly ablate the endometrium, making it particularly suitable for outpatient or day-care settings. Studies report amenorrhea or significant improvement in bleeding patterns in 70–90% of treated women, with low rates of adverse events [6].

Given the burden of AUB, especially in low-resource settings, and the limitations of long-term medical therapy, evaluating the effectiveness of TBEA provides clinically relevant evidence for gynecologists seeking safe, affordable, and patient-centred management options. This study aims to assess the clinical outcomes, symptomatic relief, and hematological improvement following thermal balloon endometrial ablation in women with AUB unresponsive to medical treatment.

METHODOLOGY

This hospital-based prospective observational study was conducted in the Department of Obstetrics and Gynecology at Sanjay Gandhi Memorial Hospital, New Delhi, over a period of one year. A total of 30 women aged 35–50 years with abnormal uterine bleeding (AUB) unresponsive to at least six months of medical therapy were enrolled after fulfilling the inclusion criteria and providing informed consent. Women were included if they had completed family size, had an endometrial thickness less than 12 mm, and a uterocervical length between 4–12 cm as assessed on transvaginal ultrasonography. Patients with endometrial hyperplasia with atypia or malignancy, gross uterine anomalies, pelvic infections, or prior major uterine surgeries were excluded. Baseline evaluation included detailed history, menstrual and obstetric profile, PBAC scoring, pelvic examination, Pap smear, endometrial biopsy, ultrasound assessment, and hemoglobin estimation.

All eligible women underwent thermal balloon endometrial ablation (TBEA) under short general anesthesia or intravenous sedation with paracervical block. After cervical dilation to 6 mm, the balloon catheter was inserted and filled with 17–20 mL of 5% dextrose, maintaining a pressure of 230–240 mmHg. The system automatically heated the fluid to 78°C, delivering a standardized 10-minute ablation cycle. Postoperatively, patients were monitored and discharged once stable, with instructions for follow-up at 10 days, 1 month, and 3 months. At each visit, menstrual outcomes were assessed using PBAC scoring and patient-reported symptoms; endometrial thickness and hemoglobin were re-evaluated at the third-month follow-up. Primary outcomes included changes in menstrual

bleeding patterns, PBAC score, endometrial thickness, hemoglobin levels, and patient satisfaction, while secondary outcomes included postoperative complications and need for re-intervention.

Results

TABLE 1. Demographic & Anthropometric Profile of Patients (n = 30)

Parameter	Category	n (%) / Mean ± SD (Range)
Age (years)	–	**44.03 ± 4.23** (36–50)
Socioeconomic status	Lower / Lower-upper	30 (100%)
BMI category	Underweight (<18.5)	1 (3.3%)
	Normal (18.5–24.9)	13 (43.3%)
	Overweight (25–29.9)	7 (23.3%)
	Obese (≥30)	9 (30.0%)
Mean BMI (kg/m²)	–	**26.69 ± 6.81** (18.4–52.3)

The mean age of the study population was 44.03 ± 4.23 years, with participants ranging from 36 to 50 years, indicating that the majority of women were in the late reproductive to perimenopausal age group, where abnormal uterine bleeding is commonly encountered. All 30 women (100%) belonged to the lower or lower-upper socioeconomic class as per the Modified Kuppuswamy Scale, reflecting the patient demographic typically accessing government healthcare facilities. Evaluation of anthropometric characteristics showed that the mean BMI was 26.69 ± 6.81 kg/m² (range: 18.4–52.3), placing the average participant in the overweight category. BMI distribution revealed that 43.3% of women had normal weight, while a substantial proportion were either overweight (23.3%) or obese (30%), together accounting for more than half (53.3%) of the study population. Only one participant (3.3%) was underweight. The high prevalence of elevated BMI is noteworthy, as obesity is a well-established risk factor associated with abnormal uterine bleeding.

TABLE 2. Obstetric History of Study Participants

Parameter	Category	n	%
Parity	P1	5	16.7
	P2	5	16.7
	P3	7	23.3
	P4	9	30.0
	P5 or more	4	13.3
Abortion history	None	9	30.0
	One	10	33.3
	>1	11	36.7

The obstetric profile of the study participants showed that most women were multiparous. Nearly one-third of the participants were para 4 (30%), followed by para 3 (23.3%), indicating that over half (53.3%) had a parity of three or more. Women with parity 1 and 2 constituted 16.7% each, while 13.3% of the sample had a parity of five or more. This reflects a predominantly high-parity population, which is commonly observed in women presenting with abnormal uterine bleeding in the perimenopausal age group. Regarding abortion history, 70% of women reported at least one prior abortion. Of these, 33.3% had a single abortion, while 36.7% had undergone more than one, suggesting a significant proportion of women had previous pregnancy losses. Only 30% of participants had no history of abortion. This obstetric background provides important insight into reproductive events that may influence menstrual abnormalities and healthcare-seeking patterns.

TABLE 3. Presenting Complaints & PBAC Scores

Parameter	Category	n	%
Duration of symptoms	1–2 years	10	33.3
	2.1–4 years	16	53.3
	>4 years	4	13.3
Mean duration (years)	–	**2.94 ± 1.13** (1–5)	–
Type of bleeding	Polymenorrhoea + Menorrhagia	14	46.7
	Menorrhagia	12	40.0
	Menometrorrhagia	2	6.7
	Frequent irregular bleeding	2	6.7
Dysmenorrhea	Present	15	50.0
PBAC Score	<500	1	3.3
	500–700	8	26.7
	700–900	20	66.7
	>900	1	3.3
Mean PBAC score	–	**740 ± 108.8** (470–960)	–

Analysis of presenting complaints revealed that the duration of abnormal uterine bleeding symptoms ranged from 1 to 5 years, with a mean duration of 2.94 ± 1.13 years, indicating that most women had been symptomatic for a considerable period before seeking interventional treatment. More than half (53.3%) experienced symptoms for 2.1–4 years, while 33.3% had symptoms for 1–2 years, and 13.3% reported symptoms persisting for over four years. The most common pattern of bleeding was polymenorrhoea with menorrhagia, reported by 46.7% of participants, followed by isolated menorrhagia in 40%. Less frequent presentations included menometrorrhagia and frequent irregular bleeding (both 6.7%). Dysmenorrhea was also a significant accompanying symptom, affecting 50% of the women. Pre-treatment menstrual blood loss was objectively assessed using the PBAC score, with the majority (66.7%) showing scores between 700–900, indicative of severe blood loss. Only one patient each fell in the <500 and >900 categories, while 26.7% had PBAC scores between 500–700. The mean pre-treatment PBAC score was 740 ± 108.8, confirming that most patients experienced high-volume bleeding necessitating procedural intervention.

TABLE 4. Pelvic Examination & Investigations

Parameter	Category/Mean	n	%
Uterus size	Normal	16	53.3
	6 weeks	2	6.7
	Bulky	12	40.0
Uterocervical length (cm)	Mean ± SD	**9.13 ± 0.91** (8–12)	–
Pap smear	Normal	12	40.0
	Inflammatory	18	60.0
Endometrial biopsy	Proliferative	24	80.0
	Secretory	6	20.0
Endometrial thickness (USG, mm)	Mean ± SD	**9.24 ± 1.26** (6.8–11.2)	–

Pelvic examination findings revealed that just over half of the women (53.3%) had a uterus of normal size, while 40% were noted to have a bulky uterus, and a small proportion (6.7%) had a uterine size corresponding to approximately six weeks of gestation. The mean uterocervical length measured 9.13

± 0.91 cm (range 8–12 cm), indicating that all patients fell within the acceptable anatomical criteria for thermal balloon endometrial ablation. Cervical cytology results showed that 40% of participants had normal Pap smear findings, whereas the remaining 60% exhibited inflammatory changes, likely reflecting benign cervicitis commonly seen in this age group. Histopathological assessment of the endometrium demonstrated that a majority of patients (80%) had a proliferative endometrium, while 20% showed secretory phase changes; importantly, no atypical hyperplasia or malignancy was identified. Pre-procedural transvaginal ultrasonography documented a mean endometrial thickness of 9.24 ± 1.26 mm (range 6.8–11.2 mm), consistent with the study's inclusion criteria and confirming suitability for ablation therapy.

TABLE 5. Pre- vs Post-treatment PBAC, ET & Hemoglobin Changes (n = 30)

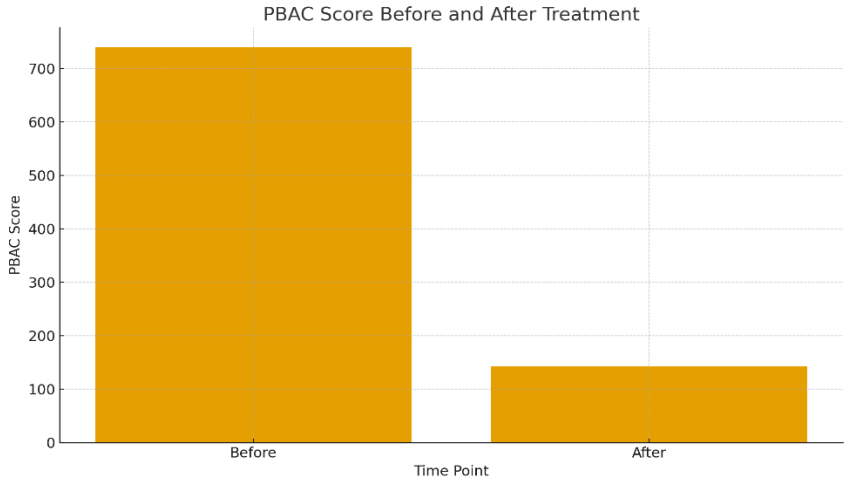
(A) PBAC Score & Endometrial Thickness

Parameter	Before Treatment (Mean ± SD)	After 3 Months (Mean ± SD)	Mean Change ± SD	% Change	p-value
PBAC score	740.0 ± 108.8	142.8 ± 189.6	−597.2 ± 202.5	80.7% ↓	**<0.001**
Endometrial thickness (mm)	9.24 ± 1.26	5.55 ± 0.47	−3.70 ± 1.26	40.0% ↓	**<0.001**

(B) Hemoglobin

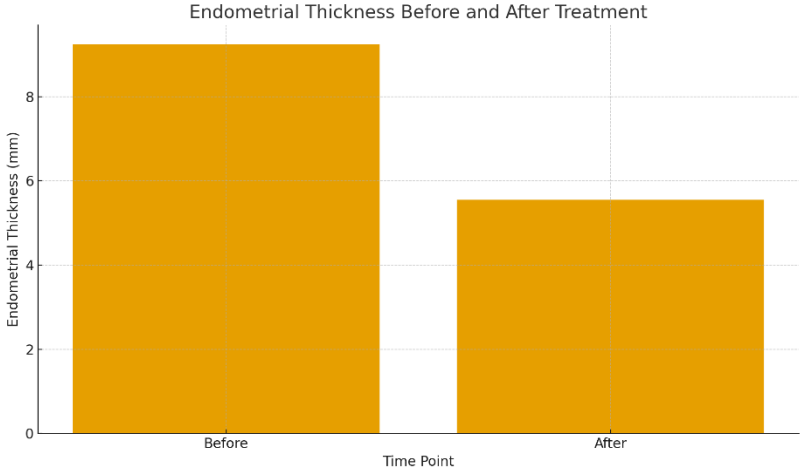
Parameter	Before Treatment	After 3 Months	Mean Change	p-value
Hemoglobin (g/dL)	9.43 ± 1.13	9.87 ± 0.76	+0.44 ± 1.03	**0.027**

Fig -1-PABC Before and After Treatment.



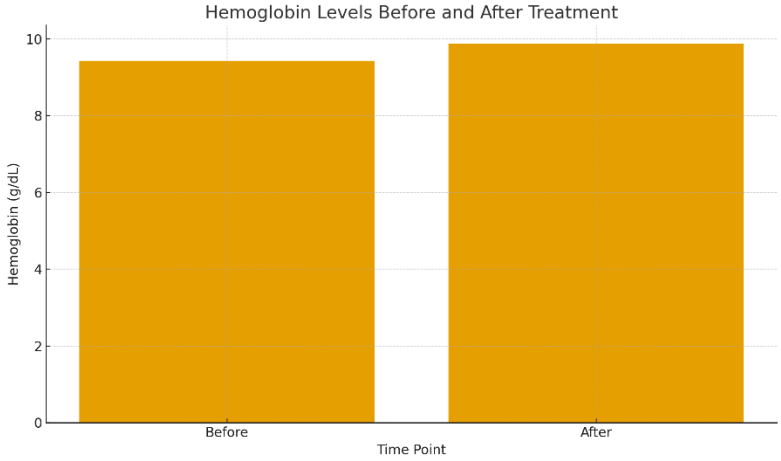
Thermal balloon endometrial ablation produced a marked improvement in menstrual blood loss and uterine parameters over the three-month follow-up period. The mean PBAC score demonstrated a highly significant reduction from 740.0 ± 108.8 before treatment to 142.8 ± 189.6 at three months, reflecting an 80.7% decrease (mean change: −597.2 ± 202.5; $p < 0.001$).

Fig 2 – Endometrial Thickness.



Similarly, the mean endometrial thickness showed a significant decline from 9.24 ± 1.26 mm to 5.55 ± 0.47 mm, indicating a 40% reduction following ablation (mean change: −3.70 ± 1.26; $p < 0.001$).

Fig 3- Haemoglobin Levels.



Hematological improvement was also evident, with mean hemoglobin levels increasing from 9.43 ± 1.13 g/dL to 9.87 ± 0.76 g/dL after three months, representing a statistically significant rise (mean change: +0.44 ± 1.03 g/dL; $p = 0.027$). Collectively, these findings highlight the efficacy of thermal balloon ablation in substantially reducing menstrual blood loss, normalizing endometrial thickness, and improving hematological status in women with abnormal uterine bleeding refractory to medical therapy.

DISCUSSION

Abnormal uterine bleeding is a major gynecological concern, particularly in perimenopausal women, and often leads to significant deterioration in quality of life and work productivity. In the present study, the mean age of participants was 44 years, consistent with the peak age of dysfunctional uterine bleeding reported in global epidemiological studies [7]. A high proportion of women were overweight or obese, which aligns with existing evidence suggesting that increased adipose tissue contributes to unopposed estrogen action and endometrial proliferation, ultimately predisposing women to AUB [8]. The majority of participants were multiparous and belonged to a lower socioeconomic background, similar to demographic patterns observed in large population-based studies from India and other low-resource settings [9]. These baseline findings contextualize the clinical burden of AUB and its tendency to be underdiagnosed or inadequately treated in resource-limited environments.

The current study demonstrated that thermal balloon endometrial ablation (TBEA) is a highly effective minimally invasive alternative for women who have failed medical therapy. The significant

reduction in PBAC scores—an 80.7% decrease from baseline—highlights the strong therapeutic potential of TBEA in providing rapid symptomatic relief. Similar reductions have been documented in earlier clinical trials evaluating second-generation ablation systems [10]. The procedure also resulted in a substantial 40% reduction in endometrial thickness, confirming adequate endometrial destruction and supporting the physiological basis of the treatment's effectiveness [11]. Hemoglobin improvement following the procedure further emphasizes the clinical benefit in terms of reducing anemia, which is a frequent complication of chronic heavy menstrual bleeding [12]. The safety profile observed in this cohort, with no major intraoperative or postoperative complications, mirrors the low complication rates consistently reported for TBEA in international literature [13]. The uniform ablation achieved through balloon-mediated thermal delivery minimizes the risk of uterine perforation and fluid overload compared to first-generation ablation techniques [14-17].

In terms of patient experience, high satisfaction levels observed in the study are in line with earlier reports that describe TBEA as a procedure associated with minimal discomfort, rapid discharge, and quick return to daily activities [18-20]. Given its ease of use, limited requirement for surgical expertise, and suitability for daycare settings, TBEA is particularly beneficial in regions where access to advanced surgical facilities is limited. Overall, the study reinforces the role of thermal balloon endometrial ablation as a safe, effective, and patient-centered treatment modality for AUB, especially for women seeking a uterine-preserving alternative to hysterectomy after failure of medical therapy.

CONCLUSION

The present study demonstrates that thermal balloon endometrial ablation (TBEA) is a highly effective, safe, and minimally invasive treatment option for women with abnormal uterine bleeding unresponsive to medical therapy. The procedure resulted in a significant reduction in menstrual blood loss, as evidenced by marked improvement in PBAC scores, along with a substantial decrease in endometrial thickness and a meaningful rise in hemoglobin levels. Additionally, TBEA was well tolerated, with no major complications and high levels of patient satisfaction. These findings support the use of thermal balloon ablation as a reliable alternative to hysterectomy, especially in resource-limited settings where access to advanced surgical interventions may be restricted. Incorporating TBEA into routine clinical practice can provide effective symptom relief, improve quality of life, and reduce the overall burden of AUB on women and healthcare systems.

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