A Supplement to Ob.Gyn. News®

CLINICAL UPDATE

Evaluating Endometrial Ablation Options:
A Guide for Evidence-Based Decision Making

Hector O. Chapa, MD
Medical Director and Outreach Coordinator
Women's Specialty Center
Clinical Faculty
Methodist Medical Center
Department of Obstetrics and Gynecology Residency Program
Dallas, TX

Lowell L. McCauley, MD, PC
Obstetrician/Gynecologist
Knoxville, TN

Idiopathic menorrhagia affects an estimated 10% to 30% of women of reproductive age,[1] and at least 22% of gynecologic referrals are related to menstrual disorders.[2] In the United States, it is estimated that menorrhagia is responsible for about $1 billion in direct costs and $12 billion in indirect costs annually. Additionally, approximately 30% of the 600,000 hysterectomies performed annually in the United States are for heavy menstrual bleeding.[3,4]

As gynecologists strive to incorporate more minimally invasive options, global endometrial ablation (GEA) technology is now providing an alternative to traditional surgical extirpative management. However, there is now wide variation in the preferred endometrial ablation device and whether GEA should be done under general anesthesia in a hospital setting or under local anesthesia/sedation in an office setting.[5] Unfortunately, despite a variety of GEA options, randomized trials comparing clinical outcomes among these ablative technologies are infrequent. We, therefore, sought to review the peer-reviewed literature addressing clinical outcomes between GEA devices so that obstetrician/gynecologists will have better information to make clinical decisions.

The Evolution of Thermal Balloon Therapy

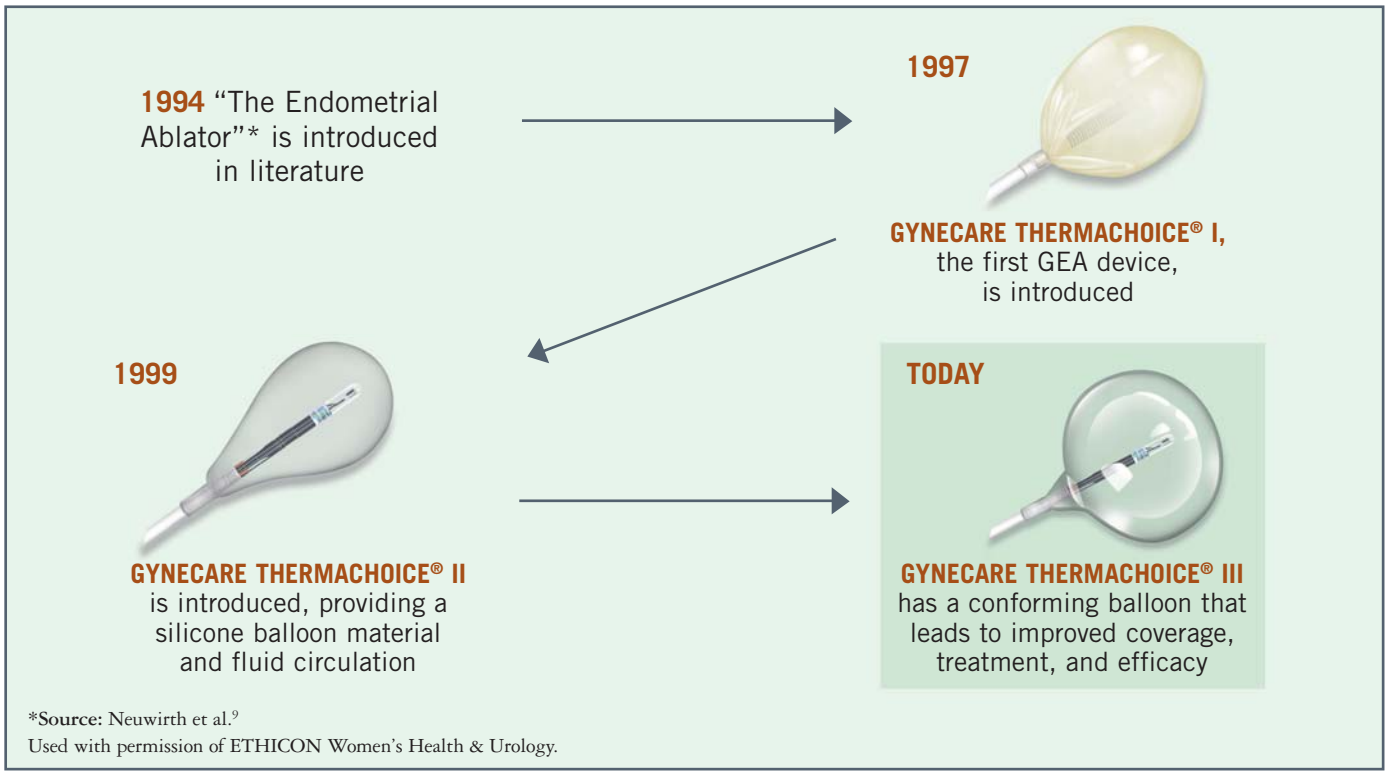
Although endometrial destructive options had previously been described,[6-8] the first global ablation device was reported by Neuwirth et al in 1994.[9] "The Endometrial Ablator" provided an alternative to point-specific endometrial resection techniques that were time consuming and highly dependent upon the surgeon's hysteroscopic skill level (**Figure 1** on page 2). The device used a latex balloon containing dextrose 5% in water to ablate the endometrial lining. This technological concept provided the foundation for the first GEA

Faculty Contact and Disclosure

Dr Chapa is a medical consultant for ETHICON Women's Health & Urology and has coauthored its Professional Education Content for *ThermaChoice Balloon Ablation*.

Dr McCauley is a medical consultant for ETHICON Women's Health & Urology. To date, he has successfully completed more than 400 Thermachoice III endometrial ablations and serves as a physician educator and trainer for the procedure.

FIGURE 1. Thermal Balloon Evolution



*Source: Neuwirth et al.[9]
Used with permission of ETHICON Women's Health & Urology.

device to be approved by the US Food and Drug Administration (FDA) for clinical use, the Thermachoice Thermal Balloon Ablation system (Gynecare, Inc) in 1997. In 2001, there was the introduction of other GEA technologies, including NovaSure radiofrequency ablation (Hologic Corporation), cryoablation (American Medical Systems, Inc), and hydrothermablation (Boston Scientific Corporation). The latest technology to enter the practice field was microwave ablation (Microsulis) in 2003.

The original pivotal trial of Thermachoice I supporting the efficacy of the thermal balloon device was a prospective randomized trial that compared the device to rollerball (RB) resection at 12, 24, and 36 months.[10] In this multisite study, an amenorrhea rate of 14.2%, based on an intent-to-treat (ITT) analysis, was observed at 12 months, comparable to RB outcomes. Conclusions from this trial stated that thermal balloon ablation was associated with fewer intraoperative complications and shorter procedure times than was RB resection, while being as effective as RB ablation in reducing menstrual bleeding to a clinically acceptable level.

Similarly, long-term outcome measures from a patient population treated with this original Thermachoice I design were reported by Amso et al.[11] Results from this multicenter study stated that at 4 to 6 years after uterine balloon therapy, the probability of avoiding hysterectomy was 86%, and the probability of avoiding reablation was 88%. Overall, the probability of avoiding any surgery was 75%. Among the participants, 47% of the nonhysterectomized women were amenorrheic, 30% of these women were hypomenorrheic, and 13.6% of these women were eumenorrheic.

In 1999, Thermachoice II entered clinical use with a redesigned uterine balloon, now composed of silicone rather than latex. The switch to silicone allowed the device to conform more thoroughly to the endometrial cavity wall, which in turn allowed for improved heat transfer between the balloon and uterine wall, increasing the resulting amenorrhea rate among an ITT population to 26%.[12] In 2006, however, Thermachoice III was approved for clinical use and is the only commercially available thermal balloon currently approved by the FDA. The FDA-approved indication for all GEA devices is menorrhagia in a premenopausal woman who is not pregnant, does not wish to become pregnant, and has not had a classical transmural cesarean section. Other contraindications include a known or suspected endometrial carcinoma or premalignant change of the endometrium, a previous transmural myomectomy, an active genital or urinary tract infection at the time of the procedure, or the presence of an intrauterine device (IUD).[10]

The latest generation of this thermal balloon allows for even more global contact with the uterine wall because of its more conforming silicone material. In a multicenter, prospective trial of patients diagnosed with menorrhagia, Garza-Leal et al[13] compared Thermachoice III to a historic control group treated with Thermachoice I. The study found statistically significant differences in amenorrhea rates with the third-generation balloon. In this 12-site, 250-patient cohort analysis, menstrual pattern results at 12 months were as follows: 81%, eumenorrhea (94%, ITT analysis) and 37%, amenorrhea (44.6%, ITT analysis), with a preexisting dysmenorrhea reduction rate of 89% (Thermachoice III has been proven to treat heavy bleeding and shown to reduce pain associated with menorrhagia as a second quality-of-life end point). In this study, although patients were to undergo preablation dilation and curettage (as per Thermachoice I trial design), not all patients underwent preprocedure dilation and curettage (D&C) because of individual physician practice. ITT analysis showed no significant impact of preprocedure curettage on treatment outcomes.[10]

A recently published study by Varma et al[5] confirmed differences in clinical outcome between Thermachoice I and Thermachoice III. Their prospective cohort study found significant differences over a mean follow-up period of 30 months. Multivariate analysis, correcting for all baseline and periprocedure characteristics, showed that Thermachoice III, when compared to Thermachoice I, increased the likelihood of amenorrhea (P=0.001). Interestingly, the authors also noted that regardless of Thermachoice design/generation, higher mean procedural intrauterine pressure correlated with better long-term patient satisfaction. Over the course of the study period, 92% of patients treated with Thermachoice III required no further therapy for abnormal uterine bleeding (AUB) versus 70.6% of patients treated with Thermachoice I.

In a separate US prospective study using Thermachoice III, Chapa et al[14] reported evaluable amenorrhea rates of 63% and eumenorrhea rates of 33% at 24 months in a cohort of 148 women who had not reached menopause. The average patient age in this study was 41 years, with a range of 29 to 48 years. A total of 122 patients (82%) were available for evaluation at 12 and 24 months. The research team also reported that amenorrhea and the reduction in dysmenorrhea persisted for 2 years after thermal balloon ablation, and 96% of these patients required no further treatment. The study provides the first prospective 2-year outcome data for Thermachoice III performed under local anesthesia with lower uterine block in an office setting.

The 4% failure rate in the study by Chapa et al[14] compares favorably with published failure rates of therapy with prior generations of thermal balloons. A hysterectomy rate of 2.4% at 24 months was documented for this cohort after Thermachoice III therapy (**Table 1**). This hysterectomy rate is in contrast to the 10% probability of hysterectomy reported for 24 months by Longinotti et al[15] after therapy with prior generations of Thermachoice. Similar to the study by Garza-Leal et al,[13] the trial by Chapa et al[14] found statistically significant dysmenorrhea reductions at both 12 and 24 months following Thermachoice III therapy (**Table 2**).

Critical review of the report by Longinotti et al[15] is necessary for appropriate extrapolation to current clinical practice. For example, based on the time frame for patient treatment, the authors report clinical outcomes following thermal balloon ablation (versions I and II), as well as radiofrequency, hydrothermablation, and point-specific RB destruction. Follow-up was set for up to 8 years. At 8 years, 20% to 22% of

TABLE 1. 24-Month Menstrual Outcomes After Thermachoice III

Outcome	12 Months (N=125) (84% of cohort)	24 Months (N=122) (82% of cohort)	*P* Value
Amenorrhea	83 (66%)	77 (63%)	0.8 (1.2 – 2.4)
Hypomenorrhea	39 (31%)	40 (33%)	0.7 (-2.3 – -1.0)
Failure	3 (2.4%)	5 (4.0%)	0.7 (-0.8 – 1.1)

Hysterectomy rate was 3/122 (2.4%) at 24 months.
Source: Chapa et al.[14]
Used with permission of *Journal of Gynecologic Surgery*, Mary Ann Liebert, Inc.

TABLE 2. Reduction in Dysmenorrhea Based on Visual Analog Scale (VAS) Score

	Baseline	12 Months	24 Months
n/N (%)	79/115 (69)	15/79 (18.9)	14/76 (18.4)
Mean VAS*	6.83	2.1	2.3

*VAS Score.
Paired T-test for statistical significance.
P<0.05 statistically significant.
P=0.002 between baseline and 12 months; P=1.1 between 12 and 24 months.
Source: Chapa et al.[14]
Used with permission of *Journal of Gynecologic Surgery*, Mary Ann Liebert, Inc.

the population required a hysterectomy after ablation therapy as a whole. The authors' conclusion was that patient age at the time of therapy was the most important factor in predicting future hysterectomy. Of those with subsequent hysterectomy, the most common pathological findings were uterine myomas (33.4%), adenomyosis (23.6%), and both uterine myomas and adenomyosis (22.4%). A close review of the life-table analysis from that cohort (**Figure 2**) reveals a slower rate of increase for hysterectomy probability with thermal balloon ablation, despite an earlier-generation technology being used at that time (**Figure 2**).

An important difference between prior generations of thermal balloon therapy and Thermachoice III is improved depth of necrosis of the endometrium, basalis layer, and inner myometrium. Perihysterectomy tissue examination has documented an increased depth of tissue necrosis and fibrosis per generation thermal balloon at all cavitary sites (cornua, midbody, and fundus).[16]

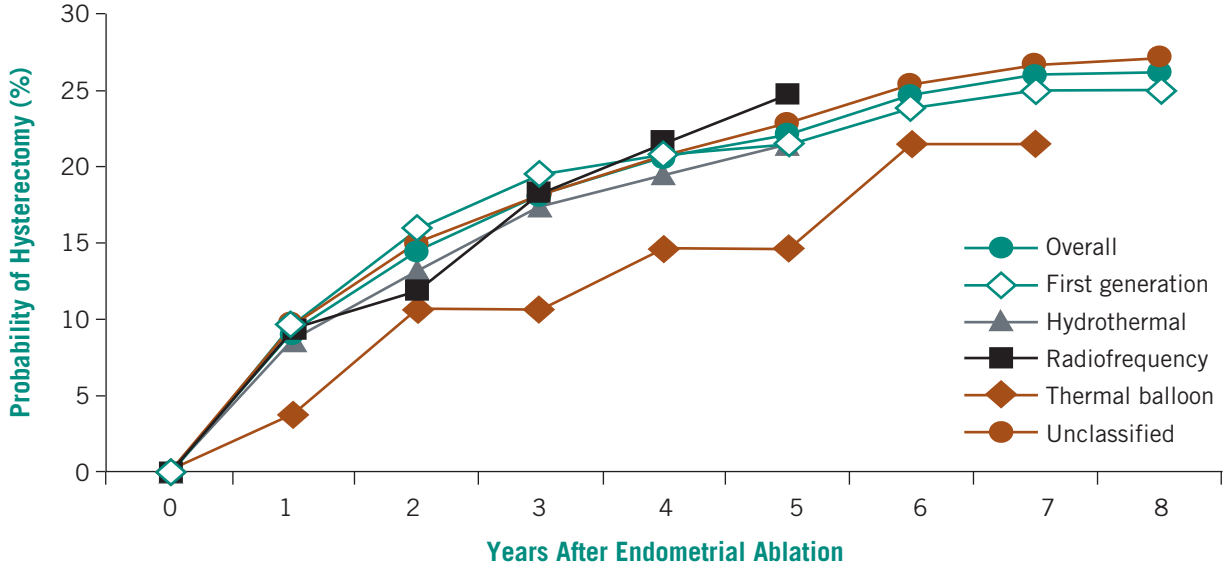
Peer-reviewed published data suggest that improved menstrual outcomes observed after Thermachoice III therapy, when compared to those after Thermachoice I, are the result of enhanced heat transfer from the balloon device to the inner uterine tissues.[5] This enhanced heat transfer, coupled with the tissue's natural healing after thermal injury, helps explain the mechanism of action after thermal balloon endometrial ablation.

Understanding the Mechanism of Action for Thermal Balloon Therapy

The original mechanism of action for thermal balloon ablation has been described by Järvelä et al.[17] The authors performed color Doppler pulsativity indices at the main branch of the uterine arteries (including the arcuate arteries) and at the subendometrial spiral arteries at baseline and at 6 months after Thermachoice I. A significant rise from the pretreatment level was observed in the pulsativity index in the uterine arteries and in the spiral artery 6 months after therapy. They concluded that thermal balloon endometrial ablation therapy induces a rise in uterine blood flow impedance, with maximal change recorded at 6 months posttherapy. According to their published report, no initial rise in vascular impedance was noted during the first 2 to 4 weeks after thermal injury. What ensued thereafter was a gradual process of chronic reparative myometrial change leading to ultimate fibrosis of the injured area. This development, together with the coagulation of the endometrial lining, translated clinically into reduced menstruation.

Clinical results after thermal balloon ablation are apparent at the next menstrual cycle, yet because of the chronic reparative process described here, maximal reduction may occur from 4 to 6 months postablation as final full fibrosis of the basement membrane and vasculature is established. The data from Järvelä et al[17] provide a more sophisticated insight into the mechanism of action of thermal balloon therapy. This mechanism of action is specific for the technology and is different from the mechanism of injury after either radiofrequency or cryoablation.

FIGURE 2. Probability of Hysterectomy by Endometrial Ablation Technique: Life-Table Method



Source: Longinotti et al.[15]
Used with permission of *Obstetrics and Gynecology*, Wolters Kluwer/Lippincott, Williams, and Wilkins.

TABLE 3. Menstrual Outcomes After Thermachoice III Endometrial Ablation

	3 Months (Eval N=134)	6 Months (Eval N=134)	*P* Value 3 and 6 Months	12 Months (Eval N=125)	*P* Value 6 and12 Months
Amenorrhea	70/134(52%)	68/134(50%)	0.98 (1.0–2.2)	83/125(66%)	.023 (-2.6 to–1.5)
Hypomenorrhea	64/134(48%)	63/134(48%)	1.01 (.98–1.9)	39/125(31%)	.012 (2.1–3.4)
Failure	–	3/134 (2.2%)*			

McNemar Test for statistical values. Eval=Evaluable cohort.
P<0.05 statistically significant. Confidence interval (CI)=95%.
*The three failures were noted at 6 months. No additional failures were documented after the 6-month period. At 12 months, the evaluable cohort was N=125; thus, 3/125 is 2.4% failure at 12 months.
Mean patient age at recruitment (baseline)=41 years (range, 29–48), median, 43 years.
Source: Chapa et al.[19]
Used with permission of *Journal of Reproductive Medicine*.

Clinically, results from Chapa et al[18] reflect this mechanism of action (**Table 3**). At 3 months after Thermachoice III ablation, the amenorrhea rate was 52%; an amenorrhea rate of 50% at 6 months was noted in the evaluable cohort (*P*=0.09). At 12 months, the evaluable cohort amenorrhea rate was 66% (*P*=0.023) compared to the results at 6 months.[19] Results were reported in a patient population whose mean age at initial recruitment was 41 years, with menopause cited as not being a confounding variable.

Menorrhagia-Associated Dysmenorrhea

According to the medical literature, isolated menorrhagia is rare. In fact, quality-of-life–impacting dysmenorrhea has been reported to occur in up to 90% of those suffering with heavy menstrual bleeding.[20] Of those with reported dysmenorrhea, 51% report that it limits their daily activities.[21] Additionally, women with dysmenorrhea have significantly lower scores for virtually all domains of the Short Form-36 (*P*<0.01), compared to those without menstrual pain.[22] With the original thermal balloon design, Meyer et al[23] reported a 70% reduction in dysmenorrhea following thermal balloon ablation and a 75% reduction in dysmenorrhea following RB, with improved quality-of-life issues. According to a prior published Swedish survey of women with dysmenorrhea, the severity of dysmenorrhea was directly related to the duration and amount of menstrual flow.[24] Speroff et al[25] describes the physiologic increase in prostaglandin $F_2\alpha$ levels in the endometrium in women with dysmenorrhea, with a peak in levels during menstruation. It is the belief of the authors that as the endometrial basalis and inner myometruim are fibrosed by ablative therapy, subsequent prostaglandin synthesis and propagation would be reduced. This development, coupled with decreased menstrual flow, would contribute to decreased menstrual pain and cramps. **Table 4** on page 6 provides extrapolated data on dysmenorrhea reduction per ablation technology gathered from each device's instructions for use (original pivotal trials) or from original study data.

Importance of Endometrial Cavitary Coverage for Outcome Success

As mentioned previously, paramount to GEA success is the ability of the technology to appropriately cover the entire endometrial cavity and provide complete and thorough thermal heat transfer to affect endometrial tissue destruction. In contrast to the more "global" uterine coverage with a flexible fluid-filled balloon, research from Samuel et al[26] describes uterine coverage with a rigid radiofrequency device. In their cohort of 38 patients treated by radiofrequency ablation, 9 of 38 women (24%) were found to have an "incompletely treated" endometrial surface on immediate postablation hysteroscopy. Although no statistically significant difference in outcomes was noted between the "incompletely treated" and "completely treated" groups, the time end point for the study was only 6 months. Longer-term data are needed to determine the effect of "incompletely treated" endometrium on outcome success. It is presumed that the etiology of the incomplete treatment of the cavity is primarily a function of the rigid design of the array.

A Review of Research on Clinical Efficacy

Although recent publications have addressed the differences in clinical outcomes between the three thermal balloon generations, outcome data from Thermachoice I persist in the current medical literature, despite the absence of Thermachoice I from clinical use since 1999. In a comparative 5-year outcome study, Kleijn et al[27] evaluated

the amenorrhea rate, hysterectomy rate, and quality-of-life in patients for 5-year status after therapy with NovaSure or Thermachoice (first generation). Results showed an amenorrhea rate of 48% for NovaSure and an amenorrhea rate of 32% for Thermachoice. Eight subsequent hysterectomies were performed following radiofrequency ablation, whereas five hysterectomies were performed after thermal balloon therapy. Severe dysmenorrhea, which existed in more than 30% of the women at baseline, was reduced in both radiofrequency and thermal balloon treatment groups (P=0.001). Kleijn et al[27] also found that there were no significant differences in health-related quality-of-life between the bipolar group and the balloon group. Nor was there a significant interaction between time and treatment effect. Equal improvements in overall health-related quality-of-life scores were reported following both therapies at 5 years.

Similarly, a recent publication by El-Nashar et al[28] described a retrospective cohort analysis of patients treated from 1998 to 2005. Treatment modalities were either NovaSure radiofrequency ablation or Thermachoice. According to years of patient treatment, the thermal balloon generations employed were Thermachoice I and Thermachoice II, as treatment data were gathered prior to clinical use of Thermachoice III. Although amenorrhea rates of up to 70% were noted following radiofrequency ablation, caution is advised in the interpretation of these data as menopausal status was not accounted for in that cohort.

Although Thermachoice III is not approved for use with uterine myomas, two recent reports by Chapa et al[14,18] concluded that the conforming nature of the Thermachoice III balloon allows for uterine coverage despite submucosal distortion by myomas. In a report by Sabbah et al,[29] 12-month clinical follow-up was reported after radiofrequency ablation in patients with similar intracavity disease, namely distortion of the endometrial surface by fibroids. Prospective analysis of this 65-patient Caucasian cohort showed an amenorrhea rate of 69%, a hypomenorrhea rate of 20%, and an eumenorrhea rate of 6%. A few cautionary interpretation comments must be mentioned about this study. The median patient age was 45 years (range, 31–58 years). The median uterine sound reported was 7.8, with a median fibroid size of 1.5 cm (range, 1–3 cm). Most important to mention is the inclusion of 13 postmenopausal women in the cohort used for statistical analysis (20% of the group).

As a measure of objective comparative review, **Table 4** provides a comparative summary of 12-month clinical outcomes based on the FDA pivotal trials for each device.

Thermal Balloon Ablation After Cesarean Section

Currently, the US cesarean section rate has reached an all-time high of 32%.[30] That begs the question: As multiple cesarean sections may predispose to a thinner lower uterine segment, is thermal balloon ablation a safe choice in patients presenting with abnormal uterine bleeding with a history of multiple cesarean sections? A recent Israeli descriptive study by Gangadharan et al[31] of thermal balloon ablation in women with a history of cesarean births revealed no immediate intraoperative complications. The conclusion based on these preliminary data was that "thermal balloon ablation is a feasible therapeutic option in women with dysfunctional uterine bleeding with one or more previous cesarean deliveries."

Should Thermal Balloon Therapy Be Performed in the Office?

In 2005, an estimated 10 million procedures had been performed annually in a doctor's office, twice the number of office-based surgeries that had been performed in 1995.[32] Since that time, an increasing number of "surgeries" have moved from the traditional operating room to the physicians' own office (endometrial ablations, hysteroscopy,

TABLE 4. Comparative Summary

Patient-Reported Comparisons*	Patients Experiencing Amenorrhea at 12 Months	Patients with Normal Levels or Less	Patients Experiencing Reduction in Dysmenorrhea (Pain)
GYNECARE THERMACHOICE® III[(1)]	37%	81%	89%
NovaSure®[(2)]	36%	78%	63%
Her Option®[(3)]	22%	67%	76%[(4)]
HTA System®[(5)]	35%	68%	N/A

Data not based on a head-to-head clinical study.

*Based on intent-to-treat population. **Sources:** (1) Gynecare Thermachoice III [instructions for use]. Somerville, NJ: ETHICON, Inc; 2009; (2) NovaSure [instructions for use]. Bedford, MA: Cytyc Corporation; 2004; (3) Her Option [instructions for use]. Minnetonka, MN: American Medical Systems; 2006; (4) Duleba AJ, Heppard MC, Soderstrom RM, Townsend DE. A randomized study comparing endometrial cryoablation and rollerball electroablation for treatment of dysfunctional uterine bleeding. *J Am Assoc Gynecol Laparosc.* 2003;10:17-26; (5) Hydro ThermAblator System® [instructions for use]. Natick, MA: Boston Scientific Corporation; 2005.
N/A=not available.

cystoscopy, gynecologic/obstetric dilation and curettage, and hysteroscopic sterilizations). As physicians increasingly encounter the need to improve time management and productivity/efficiency, more physicians are performing endometrial ablations in their own office rather than in a hospital or ambulatory surgical center. The concept of thermal balloon ablation under local anesthesia is not a novel concept. In 1997, Fernandez et al[33] first published the successful use of Thermachoice (first generation) under local anesthesia.[33] Since then, others have validated its use in the office setting.[22, 34-36]

The main advantages of office-based procedures include less overall time spent by the patient at the treatment site, familiarity of the surroundings, and the patient's perception of having a "procedure" versus having "surgery."

The following sample office protocols reflect the authors' opinions. Before the patient arrives in the office, she should have eaten a full meal; this preparation usually helps her tolerate the oral medication cocktail. A negative pregnancy test should be obtained immediately prior to the procedure. Once in the office, the patient's hysteroscopic exam should visualize the uterine cavity; any perforations, abnormalities, and specific intrauterine findings should be documented.

Typically, the patient may receive the oral medication cocktail from about 45 to 60 minutes prior to the procedure to allow for peak serum drug levels. Traditionally, the regimen should include a nonsteroidal anti-inflammatory drug (NSAID) such as ibuprofen, an anxiolytic, antiemetic, and narcotic analgesic.

A lower uterine block is performed immediately before the office procedure. The local anesthetic should be administered at a depth of 1.5 inches just medial to the cervico-vaginal reflection. Administering 5 to 10 cc of the local anesthetic per quadrant is recommended at 4, 8, 2, and 10 o'clock positions. The drugs typically used are lidocaine, carbocaine, and naropin. Evidence for the efficiency of such a protocol can be found in a cohort study by Chapa,[34] in which a patient cohort of 148 patients with Thermachoice III ablation under local anesthesia revealed a mean intraoperative visual analog scale (VAS) score of 2 (range, 1–3) out of a maximal scale value of 10.[34] Typical menses VAS score was recognized as a mean of 3.

Immediately after the procedure, an NSAID, a narcotic, and an antiemetic are recommended. With this approach, patients rarely experience immediate postoperative pain. To cope with late-onset postprocedure pain, most clinicians will prescribe an NSAID and narcotic analgesic at 4 hours after patients receive their first medication and then again at 8 hours.

Important to note, however, is the claim of some investigators that the etiology of postcesarean section abnormal uterine bleeding is an anatomic defect or "isthmocele" that alters the uterine/myometrial blood flow and results in a disorganized bleeding pattern. These authors[37] state that the hysteroscopic resection of this "isthmocele" may be preferred if encountered at preablation hysteroscopy. Therefore, the consensus and that of the authors of the current supplement is to perform routine diagnostic hysteroscopy before thermal balloon ablation as a conservative measure for a lower uterine segment condition. Nonetheless, the study by Gangadharan et al[31] provides evidence that thermal balloon ablation may be a valid treatment option in patients with cesarean intervention. As was mentioned previously, current FDA labeling states that only classical (fundal transmural) cesarean section is a contraindication for Thermachoice.

Although there are advantages to performing thermal balloon therapy in an office setting, there are certain clinical scenarios in which it may be inappropriate. Those patients with preexisting anxiety or panic disorder, narcotic addiction or past use, suspected endometriosis, or other chronic pain conditions or patients who simply fear an office-based procedure are candidates for considering therapy outside of the office setting.

Currently, with the recent passage of health care reform, physicians will undoubtedly face changes to everyday practice. It is evident that the known adage of "work smarter, not harder" is exemplified by office-based surgical procedures when appropriate. A classic example of this model is GEA. Although physicians are inundated with a variety of treatment options and technologies, their role is to implement evidence-based recommendations for improved patient outcomes. Any implemented technology or treatment plan should produce improved patient quality-of-life measures combined with patient safety and physician operability. Currently, there are no head-to-head, peer-reviewed trials reporting on outcomes directly comparing the different technologies. Such trials would be ideal for the gynecologic community. It is important to realize that ALL modalities require proper patient informed consent, patient selection, and physician discretion in order to achieve a favorable outcome. It is, after all, the goal of every physician to have a successful outcome, remembering always to "first do no harm."

References

1. de Souza S, Camargos AF, de Rezende CP, Pereira FA, Araújo CA, Silva Filho AL. A randomized prospective trial comparing the levonorgesterol-releasing intrauterine system with thermal balloon ablation for the treatment of heavy menstrual bleeding. *Contraception*. 2010;81:226-231.
2. Gath D, Osborn M, Bungay G, et al. Psychiatric disorder and gynaecological symptoms in middle aged women: A community survey. *Br Med J*. 1987;294:213-218.
3. Clarke A, Black N, Rowe P, Mott S, Howle K. Indications for and outcome of total abdominal hysterectomy for benign disease: A prospective cohort study. *Br J Obstet Gynaecol*. 1995;102: 611-620.
4. Falcone T, Walters MD. Hysterectomy for benign disease. *Obstet Gynecol*. 2008;111:753-767.
5. Varma R, Soneja H, Samuel N, Sangha E, Clark TJ, Gupta JK. Outpatient Thermachoice endometrial balloon ablation: Long-term, prognostic and quality-of-life measures. *Gynecol Obstet Invest*. 2010;70:145-148.
6. Munro MG. Dysfunctional uterine bleeding: Advances in diagnosis and treatment. *Curr Opin Obstet & Gynecol*. 2001;13:475-489.
7. Goldrath MH, Fuller TA, Seqal S. Laser photovaporization of endometrium for the treatment of menorrhagia. *Am J Obstet Gynecol*. 1981;140:14-19.
8. DeCherney AH, Polan ML. Hysteroscopic management of intrauterine lesions and intractable uterine bleeding. *Obstet Gynecol*. 1983;61:392-397.
9. Neuwirth RS, Duran AA, Singer A, McDonald R, Bolduc L. The endometrial ablator: A new instrument. *Obstet Gynecol*. 1994;83(5 pt 1):792-796.
10. Gynecare Thermachoice III [instructions for use]. Somerville, NJ: Ethicon, Inc; 2009.
11. Amso NN, Fernandez H, Vilos G, et al. Uterine endometrial thermal balloon therapy for the treatment of menorrhagia: Long-term multicentre follow-up study. *Hum Reprod*. 2003;18: 1082-1087.
12. Feitoza SS, Gebhart JB, Gostout BS, Wilson TO, Cliby WA. Efficacy of thermal balloon ablation in patients with abnormal uterine bleeding. *Am J Obstet Gynecol*. 2003;189:453-457.
13. Garza-Leal J, Dena A, Donovan A, et al. Clinical evaluation of a third-generation thermal uterine balloon therapy system for menorrhagia coupled with curettage. *J Minim Invasive Gynecol*. 2010;17:82-90.
14. Chapa H, Venegas G, Antometti AG, Van Duyne CP, Sandate J, Bakker K. In-office Thermachoice III ablations: 24-month prospective follow-up on menstrual patterns and dysmenorrhea impact. *J Gynecol Surg*. In press.
15. Longinotti MK, Jacobson GF, Hung YY, Learman LA. Probability of hysterectomy after endometrial ablation. *Obstet Gynecol*. 2008;112:1214-1220.
16. Summary Report: An ex-vivo study to evaluate the V1.2, V2.0 & V3.0 (Circulating and Non-Circulating) Thermachoice UBT Catheters in Extirpated Uterei. Ethicon, 2002.
17. Järvelä I, Tekay A, Santala M, Jouppila P. Thermal balloon endometrial ablation therapy induces a rise in uterine blood flow impedance: A randomized prospective color Doppler study. *Ultrasound Obstet Gynecol*. 2001;17:65-70.
18. Chapa HO, Venegas G, Antonetti AG, Van Duyne CP, Sandate J, Bakker K. In-office endometrial ablation and clinical correlation of reduced menstrual blood loss and effects of dysmenorrhea and premenstrual symptomatology. *J Reprod Med*. 2009;54:232-238.
19. Chapa HO, Venegas G, Antonetti AG, Van Duyne CP, Sandate J, Bakker K. In-office endometrial ablation using a third-generation uterine balloon therapy system: 12-month prospective follow-up on menstrual patterns and dysmenorrhea impact. *J Reprod Med*. 2009;54: 678-684.
20. Committee on Practice Bulletins–Gynecology. Practice Bulletin 110: Nonhormonal uses of hormonal contraception. *Obstet Gynecol*. 2010; 115:206-218.
21. Burnett MA, Antao V, Black A, et al. Prevalence of primary dysmenorrhea in Canada. *J Obstet Gynaecol Can*. 2005;27:765-770.
22. Barnard K, Frayne SM, Skinner KM, Sullivan LM. Health status among women with menstrual symptoms. *J Womens Health*. 2003;12:911-919.
23. Meyer WR, Walsh BW, Grainger DA, Peacock LM, Loffer FD, Steege JF. Thermal balloon and rollerball ablation to treat menorrhagia: A multicenter comparison. *Obstet Gynecol*. 1998;92:98-103.
24. Andersch B, Milsom I. An epidemiologic study of young women with dysmenorrhea. *Am J Obstet Gynecol*. 1982;144:655-660.
25. Speroff L, Glass RH, Kase NG, eds. *Clinical Gynecologic Endocrinology and Infertility*. 6th ed. Baltimore, MD: Lippincott, Williams & Wilkins; 1999.
26. Samuel NC, Karragianniadou E, Clark TJ. Outpatient versus day-case endometrial ablation using the NovaSure impedance-controlled ablative system. *Gynecol Surg*. 2009;6:3-9.
27. Kleijn JH, Engels R, Bourdrez P, Mol BW, Bongers MY. Five-year follow up of a randomised controlled trial comparing NovaSure and ThermaChoice endometrial ablation. *Br J Obstet Gynaecol*. 2008;115:193-198.
28. El-Nashar SA, Hopkins MR, Creedon DJ, et al. Prediction of treatment outcomes after global endometrial ablation. *Obstet Gynecol*. 2009;113:97-106.
29. Sabbah R, Desaulniers G. Use of the NovaSure Impedance Controlled Endometrial Ablation System in patients with intracavitary disease: 12-month follow-up results of a prospective, single-arm clinical study. *J Minim Invasive Gynecol*. 2006;13:467-471.
30. Menacker K, Hamilton BE. Recent trends in cesarean delivery in the United States. *NCHS Data Brief*, No. 35. March 2010.
31. Gangadharan A, Revel A, Shushan A. Endometrial thermal balloon ablation in women with previous cesarean delivery: Pilot study. *J Minim Invasive Gynecol*. 2010;17:358-360.
32. American Society of Anesthesiology and the Society's Committee on Communication and the Committee on Ambulatory Surgical Care. Office-Based Anesthesia and Surgery; 2006.
33. Fernandez H, Capella S, Audibert F. Uterine thermal balloon therapy under local anaesthesia for the treatment of menorrhagia: A pilot study. *Hum Reprod*. 1997;12:2511-2514.
34. Chapa HO. Utility of in-office endometrial ablation: A prospective cohort study of endometrial ablation under local anesthesia. *J Repro Med*. 2008;53:827-831.
35. Clark TJ, Gupta JK. Outpatient thermal balloon ablation of the endometrium. *Fertil Steril*. 2004;82:1395-1401.
36. Marsh F, Thewlis J, Duffy S. Thermachoice endometrial ablation in the outpatient setting, without local anesthesia or intravenous sedation: A prospective cohort study. *Fertil Steril*. 2005;83:715-720.
37. Gubbini G, Casadio P, Marra E. Resectoscope correction of the "isthmocele" in women with postmenstrual abnormal uterine bleeding and secondary infertility. *J Minim Invasive Gynecol*. 2008;15:172-175.