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A 3 year follow–up of menorrhagia in Asian women treated with Microwave Endometrial Ablation at a teaching hospital – An initial experience

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ABSTRACT

Objective: To describe the introduction of microwave endometrial ablation to clinical practice and to report on the outcomes at 3 years.

Design: A prospective observational cohort study using Microwave Endometrial Ablation (MEA) for the treatment of 16 women with failed medical management for menorrhagia.

Setting: A tertiary teaching hospital in obstetrics and gynaecology.

Main outcome measures: Symptom relief, safety profile, reduction in dysmenorrhoea and treatment time.

Results: 68.8% reported prolonged bleeding beyond 7 days while 56.3% had heavy bleeding that persisted beyond 3 days. 81.3% had concomitant dysmenorrhoea. The average treatment time for the procedure was 3.9 min. Amenorrhoea was achieved in 31.3% and dysmenorrhoea rates improved from 81.3% to 25.0% at three years. There were no intra- or post-operative complications.

Conclusions: MEA is a safe and efficient procedure with good levels of satisfaction 3 years after treatment.

INTRODUCTION

Many women suffer from menstrual abnormalities, especially from the age of 40. This often arises as a result of fibroids, hyperplasia of the endometrium, or dysfunctional uterine bleeding. Medical treatment usually represents the first line of therapy and comprises either hormonal or antifibrinolytic medications. At best, this reduces menstrual blood loss by only 50%[1]. Up to 60% of women with menorrhagia undergo hysterectomy within five years of their referral to a gynaecologist[2]. Previously, this was the only alternative to patients with failed conservative treatment. Since the late 1980s, endometrial ablation and/or resection methods have become increasingly more common in the treatment

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of abnormal uterine bleeding. This is because the majority of such patients have a normal-sized uterus with no obvious pathology (dysfunctional uterine bleeding) and such methods were expected to reduce the number of hysterectomies in the absence of pathological disease[3].

These modalities are now established methods for the treatment of heavy menstrual loss and have been compared with the hysterectomy procedure[4-10]. However, they require substantial training and experience to be performed effectively and safely. Newer endometrial ablative techniques, such as microwave endometrial ablation (MEA), have been developed and are faster and easier to perform[11-12] compared to earlier generations. Microwave endometrial ablation utilizes electromagnetic energy that allows penetration into uterine tissues of no more than 6 mm. We report on a prospective observational cohort study using Microwave Endometrial Ablation (MEA) for the treatment of 16 women with failed medical management for menorrhagia at KK Hospital, a tertiary teaching hospital in obstetrics and gynaecology.

Methods and Materials

Recruitment

Our study cohort comprised women who were referred to the gynaecology outpatient clinic at KK Women's and Children's hospital for a problem of menorrhagia. A total of 16 patients were enrolled in our pilot study between 1st September 1999 and 31st December 2000. The inclusion criteria were: a) women with menorrhagia or dysfunctional uterine bleeding and who had failed medical treatment, b) women who were premenopausal, c) those who had completed their families, d) a uterine size equivalent to 10 weeks' gestation or less and e) those with no detectable histopathological evidence of endometrial hyperplasia or cancer. All gave informed consent to participate in the study. Women were questioned on the severity of pain and bleeding for the duration of their menses.

The operating system

The MEA system comprises a software-controlled device designed to ablate the endometrial lining of the uterus using microwave energy at a fixed frequency of 9.2GHz. It consists of a console that houses a control module with an embedded computer and user-touch screen with colour display, a microwave generator, and a power supply. The microwave generator employs a high stability source and has a design life of 5 years. This is equivalent to 5,000 duty cycles. Additional components consist of a reusable hand-held applicator, a pneumatic footswitch, coaxial and data cables, a printer (optional), a power cord, and a portable trolley.

The principle of the MEA procedure

The MEA applicator serves as an interface between the Microwave module and the patient and comprises a one-piece reusable instrument that introduces microwaves at 9.2 GHz into the uterus via the cervix. The applicator shaft is graduated along its length in centimetre units and has a solid black band, extending 35 mm below the tip, which helps to indicate the tip position with respect to the endo-cervical canal. A coaxial cable transmits microwave energy to the applicator which is inserted up to the fundus of the uterus. Power to the applicator is controlled by a foot switch operated by the surgeon. Microwave energy emanates semi-radially from the applicator tip and is absorbed by the surrounding endometrial tissue, causing the temperature to rise. Likewise, when the applicator tip is moved to an untreated area, the temperature falls. Temperature measurements from the applicator tip and surrounding endometrial tissue are transmitted to a colour display and provide real-time visual feedback of the treatment temperature. Data such as the serial number of the applicator and its usage history is also recorded.

This graphical response is used to control the depth and coverage of heating during the MEA treatment. The applicator is moved slowly from side to side at the fundal area until the treatment temperature achieves the target temperature range (70 to 80 °C) displayed on the treatment screen. Once the endometrium in the fundal region is completely ablated (coagulated), treatment is continued with sweeping movements and simultaneous withdrawal of the applicator from the uterine cavity whilst ensuring that the therapeutic temperature is maintained. The applicator shaft is withdrawn until the end of the treatment band is visible.

Movement of the applicator tip to untreated endometrium is reflected as a temperature drop on the screen. This ensures that the tip is maintained at that position until the therapeutic temperature is achieved (Figure 1) and not only gives a visual representation of the actual process within the uterus but also ensures consistent endometrial ablation. An additional treatment safety factor requires that the applicator be withdrawn continuously throughout the procedure.

The system achieves complete endometrial ablation by heating a 5-6 mm layer of intrauterine tissue to therapeutic temperature levels for the duration of the treatment which averages 3 minutes for the normal size uterus (75-85 mm). When the applicator tip reaches the internal cervical os, the footswitch is released to deactivate the microwave energy and the applicator fully withdrawn. Care is required to avoid treatment of the endocervix.

The operative procedure

Pre-treatment with one dose of GnRH analogues (eg Lucrin®) four weeks prior to the procedure was advocated. Trans-vaginal ultrasound was performed in the clinic. Three consultants who were subspecialists in laparoscopic surgery performed the ablations. Patients were given general anaesthesia and had hysteroscopy using CO2 as a distending medium prior to the ablation, to exclude any intrauterine lesions. Uterine length was determined with a uterine sound, checked against a steel ruler before introduction of the applicator to the level of the fundus and then re-checked against the graduated centimetre markings on the applicator shaft following insertion. Cervical dilatation was to Hegar 9 mm. A final hysteroscopic examination was performed after the ablation. This triple check was aimed at enhancing safety and preventing inadvertent and unrecognized uterine perforation with the applicator tip.

Outcome measures

Women were questioned on the severity of their menstrual bleeding and pain. A questionnaire documented the duration of the operative treatment, concurrent procedures, intra- and post-operative complications and requirements for postoperative analgesia. Menstrual satisfaction and the degree of dysmenorrhoea were asked at each follow-up interval of 1 month, 6 months and 36 months post-operatively. Primary outcome measures were menstrual satisfaction (as evidenced by a reduction in menstrual flow) and the safety profile of the procedure. Secondary outcome measures included reduction in dysmenorrhoea. Treatment failures were analysed as well.

Results

The mean age was 43.9 years old (40-49), the median parity was 2 (0-4), the mean weight was 64.5kg (51-93) and the mean BMI was 26.8 (21-36). Six of the patients had previous ligation and five of them had had two previous Lower Segment Caesarean Sections. The mean duration of symptoms of heavy bleeding was 22.9 months (5-48). The mean pre-treatment hemoglobin level was 10.6g/dl (5.4-13). Baseline characteristics of the menstrual disturbances are outlined in Table 1. The majority of women (68.8%) reported >7 days of bleeding while 56.3% had heavy bleeding that persisted beyond 3 days. 81.3% had concomitant dysmenorrhoea.

Ten women had anteverted and anteflexed uteri while the rest were retroverted. Trans-vaginal ultrasound was performed to exclude intra-uterine lesions and to provide a more objective assessment of the uterus. Uterine measurements by ultrasound are outlined in Table 2.

Figure 1 Treatment profile of an MEA procedure

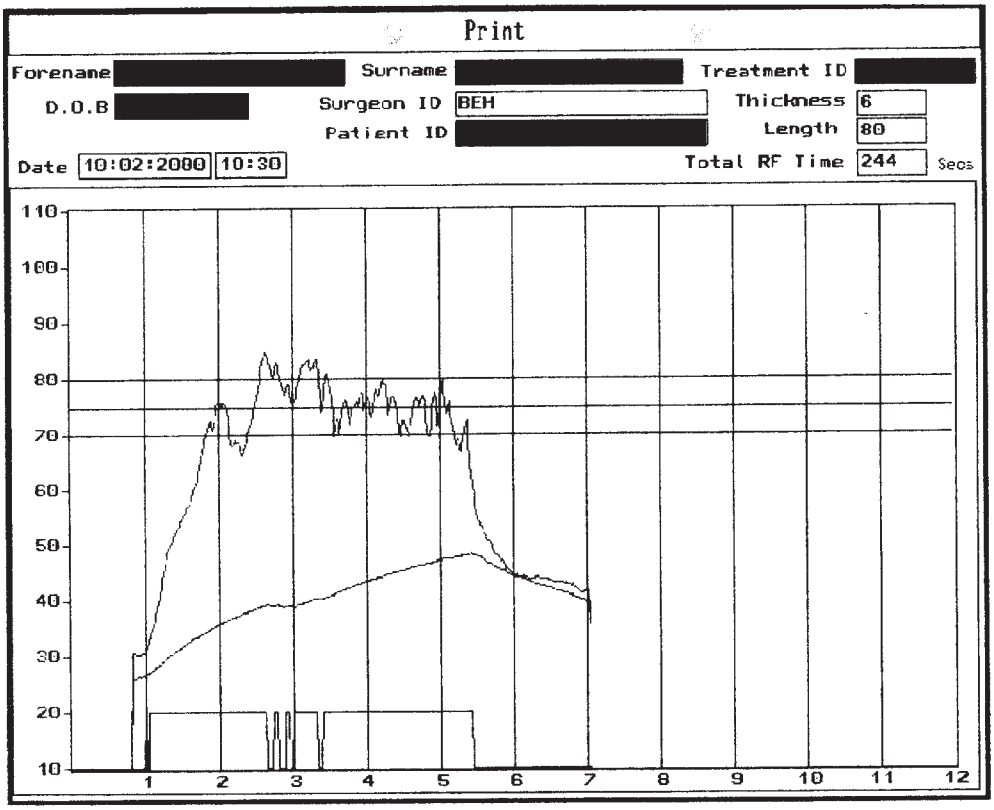

Table 1 Baseline characteristics of menstrual disturbance

Menstrual bleeding characteristics	MEA patients (n=16)
Irregular periods	6 (37.5%)
3-7 days bleeding	4 (25.0%)
>7 days bleeding	11 (68.8%)
>3 days heavy bleeding	9 (56.3%)
Double or more sanitary protection needed	12 (75.0%)
Dysmenorrhoea	13 (81.3%)

Table 2 Uterine measurement prior to endometrial ablation

Uterine parameters	Measurements (mm)
Total endometrial thickness*	11.0 (4-20)
Uterine length*	90.0 (63-112)
AP diameter*	50.2 (31-70)
Uterine sounding	82.0 (70-95)

*Measured with vaginal ultrasound. Values are given as mean (range). AP = antero-posterior.

Nine of the sixteen patients (56.3%) had a concurrent problem of small uterine myoma - the mean diameter of the myomas was 1.82 cm (0.3-3.2). Three patients had sonographic features suggestive of adenomyosis and one patient had a 0.5-cm endocervical polyp that was avulsed.

Total anaesthetic time ranged from 5 to 100 minutes with a mean of 23.9 minutes. Three patients had concurrent procedures with the MEA - two had laparoscopic cystectomy for endometriotic cysts which required an additional operating time of 51 minutes while the second had a laparoscopic myomectomy requiring an additional duration of 100 minutes. The average duration of the MEA procedure itself was 3.9 min (2.5 to 5.5). All but two patients received general anaesthesia. These two patients received local anaesthetic, via a four quadrant intracervical injection of xylocaine hydrochloride 2% (containing adrenaline diluted to 1 in 80,000).

Menstrual satisfaction was based on a reduction in menstrual flow compared to the initial bleeding pattern. The number of women who became amenorrhoeic increased from 2 women (12.5%) at 1 month, to 3 women (18.8%) at 6 months to 5 (31.3%) at 36 months. Per vaginal spotting decreased from 68.8% (11 women) to 0% at 36 months. Four women (25.0%) had normal menstrual flow at 36 months and 3 women (18.8%) reported heavier menses at 6 months. (Table 3) These 3 women comprised treatment failures.

Treatment failures were defined as women who did not report improvement in menstrual flow ie. persistent menorrhagia. There were 3 treatment failures (18.8%). Patient 7 was a 42-year old woman known to have adenomyosis but who opted for MEA despite having been advised to have a hysterectomy. Three months after the ablation, she reported heavier menstrual flows with persistent dysmenorrhoea. She

subsequently required GnRH analogue treatment. Patient 11 was a 45-year-old woman who experienced heavier menstrual flows at 6 months. She had a Dilatation and Curettage procedure, 1 year after MEA treatment, which revealed anovulatory endometrium. She opted for the Mirena® system instead of re-treatment with MEA. The last treatment failure, patient 14, was the only one out of five who had preoperative preparation with Danazol®. She was a 34-year-old para 2, with a history of endometriosis and uterine fibroids, who had also been treated earlier with GnRH analogues. She underwent a combined procedure of a hysteroscopic resection of a submucous fibroid followed by the MEA procedure. Although she reported an initial improvement in her menstrual flow, the bleeding became heavier after 6 months. She also had chronic pelvic pain requiring analgesia with NSAIDs (non-steroidal anti-inflammatory drugs). An ultrasound showed progressive enlargement of the uterus. A Laparoscopic Assisted vaginal hysterectomy was performed. Histology revealed the presence of adenomyosis.
Two women (patient 6 and 10) had additional surgical procedures in their course of follow up after the MEA treatment. Patient 6 reported a reduction in her menstrual flow leading to complete amenorrhoea by 6 months post MEA treatment. However at her 36th month of follow up, she experienced a return of regular menstrual bleeding with pelvic pain. An ultrasound showed a 3-cm fibroid and endometriotic cyst. She had a Total Laparoscopic Hysterectomy during which evidence of Pelvic Inflammatory Disease was also noted. Patient 10 reported menstrual satisfaction compared to her initial presentation of heavy menses. However, she continued to have pelvic pain. An ultrasound revealed adenomyosis for which a Total Abdominal Hysterectomy was performed 1 year after the MEA. Both women were not classified as treatment failures as these were deemed to be new pathologies.

Safety profile was based on the occurrence of intraoperative bleeding, uterine perforation, development of haematometra and intra abdominal injury. None of the patients developed these complications. Furthermore, none of them had any postoperative febrile episodes, infections or intractable pain.

13 women (81.3%) complained of dysmenorrhea preoperatively. Following MEA treatment, only one complained of persistent dysmenorrhea and an additional three complained of pelvic pain. Amongst the three women with pelvic pain, two were diagnosed to have adenomyosis, and one had endometriosis and a pyosalpinx.

The defaulter rates also increased progressively. (Table 3) Three women were lost to follow-up-one woman defaulted her follow-up after 3 months while the remaining two defaulted their follow-up 1 year after the ablation procedure.

Table 3 Outcome of MEA

	Duration of follow-up		
Outcome	**1 month (n=16)**	**6 month (n=16)**	**3 years (n=13)**
Amenorrhoea	2	3	5
Per vaginal spotting	11	5	-
Oligomenorrhoea	1	-	-
Improvement in menses	2	4	4
Treatment failures	-	3	-
Defaulted follow-up	-	1	4

Discussion

Menorrhagia, as defined as heavy menstrual bleeding, is a major clinical problem. A study in the UK depicted menstrual disorders as accounting for 2.7 % of all specialty outpatient clinic referrals in the Oxford Health Authority of which 60 % of these women had a hysterectomy within 5 years of their referral [2]. Of the total number of hysterectomies, approximately 35% are for perceived menorrhagia with no demonstrable pathology[13]. By its nature, menorrhagia is a chronic, cyclical problem which not only has physical and emotional impacts but also has social implications in which a woman's ability to carry out her normal activities may be compromised.

Heavy menstrual bleeding or menorrhagia is generally defined as blood loss in excess of 80mls at each menstrual cycle[14]. A significant number of women will develop anemia at this level and it may seem reasonable to include women with losses > 60 ml[15].

Medical treatment, with hormonal or antifibrinolytic drugs, represents the first line of therapy. At best, this reduces menstrual blood loss by only 50%[1]. Previously, a hysterectomy was the only alternative to patients with failed conservative treatment. But the associated morbidity, expense and prolonged inpatient stay prompted the search for alternatives[16-17].

Surgical alternatives have been evolving over the years. Endometrial cryosurgery was reported towards the end of the 1960s[18] while laser endometrial ablation was the first hysteroscopic technique, described by Goldrath et al[19] in 1981.This was followed in 1983 with the use of the urological resectoscope and electrocoagulation to remove the endometrium. Phipps et al[20] reported a non-hysteroscopic technique using radiofrequency. Against this background, transcervical resection of the endometrium (TCRE) and rollerball ablation (REA) evolved as the dominant hysteroscopic procedures for menorrhagia. Satisfaction rates with these techniques were high, recovery times short and the techniques safe. TCRE and REA represent the so-called 'first generation' techniques and involve direct hysteroscopic visualisation of the endometrial cavity. TCRE has been extensively evaluated in evidence-based randomized trials, meta-analyses and national audits[9, 12, 21-22]. Despite its efficacy, a number of drawbacks exist – a) a skilled hysteroscopic surgeon is required and b) complications like uterine perforation, with an incidence of 0.6% to 2.5%, and fluid deficits of greater than 2 litres, with an incidence of 1-5% have been demonstrated in the national audits[21-22]. Unlike TCRE, REA has not been evaluated so extensively but it has been compared against TCRE[12].

Various new ablative techniques then emerged from the mid-1990s; these methods were reported to be quick, safe, and easy to learn and use, yet as effective as traditional hysteroscopic surgery. They did not require continuous hysteroscopic visualisation and included second generation techniques, such as Thermal Balloon endometrial ablation (TBEA), which were described as blind and global procedures, and third generation ones like MEA (Microsulis plc,Waterlooville, Hants, UK) which were described as pseudovisual.

MEA has been tested randomised-control trials against two first-generation treatments, resection and rollerball[11-12]. In a series of cases treated by microwave endometrial ablation (MEA)[23], the success rate was 83%, with a 57% rate of amenorrhoea, and very fast treatment times (1–2 min). These results were achieved in selected women in whom the uterus was of normal size and the endometrial cavity regular.

Our cohort of patients represents a large proportion of women that attended our general gynaecological clinic in our tertiary referral centre for women's health. With the efficacy of MEA being validated by various authors, we decided to recruit a diverse population with menorrhagia in an Asian population of women in order to study the general applicability of MEA to this cohort of patients. There were a total of 16 patients studied and they were all more than 40 years old with only one lady being nulliparous.

The presenting symptoms were diverse but entry was based on a subjective complaint of menstrual loss - almost all the patients required double or more sanitary protection. Many of our patients had a concurrent problem of other uterine pathologies like fibroids, adenomyosis, and cervical polyps (56%). In fact, there were a disproportionately high percentage of patients with dysmenorrhoea (81.3%) as a result of this statistic. Although the system has been shown to be effective in women with irregularly shaped uterine cavities, fibroids < 3 cm in size and uterine cavity lengths up to and including 14 cm, the clinical parameters of our cohort of women did not exceed these measurements. Nevertheless, the wide applicability of the technique has made it more versatile as compared to the other methods of hysteroscopic ablative /resection.

Hodgson et al[11] showed an amenorrhoeic rate of 37.2% and an overall improvement in periods in 23.2% at three years. Similarly the overall dysmenorrhea rates decreased from 83.7% to18.4% at three years. In our cohort, 31.3% achieved amenorrhoea at 3 years and the dysmenorrhea rates decreased from 81.3% to 25%. These results were similar to those described by Hodgson et al[11]. A more robust method of menstrual

flow assessment, like the menstrual score questionnaire used by Hodgson et al[11], would have been beneficial to our study as it would have provided a more objective determination of the usefulness of the MEA procedure.

Preoperative preparation to "thin" the endometrium before ablation has been advocated by many authors as an important prerequisite for treatment success. It appears to play a pivotal role in the ultimate success of the procedure. In our cohort of 16 patients, 4 received Danazol® treatment for their heavy menses and another 5 had pre-operative treatment with a single dose of the GnRH analogue, Lucrin®. There was an inconsistent trend in the administration of the analogues as patients were initially managed by various gynaecologists prior to the referral. This may have contributed to the relatively high failure rates in our study.

There were a total of 3 patients who required further treatment after MEA (they were classified as treatment failures). Two of them did not have preoperative treatment with GnRH analogues or Danazol®. Therefore there were 2 out of a total of 7 women (28.6%) who did not have preoperative treatment and who were treatment failures compared to 1 out of a total of 9 women (11.0%) who received preoperative treatment and yet was a treatment failure as well. These 3 treatment failures reinforce the importance of proper preparation of the uterine lining and careful patient selection to the outcome success of the hysteroscopic ablative procedure.

The average duration of the MEA procedure itself was 3.9 minutes. This was comparable to other reported trials[8]. Significantly, the duration of the MEA procedure was less than the total time taken for general anaesthesia. MEA can be performed under local or general anaesthesia but if gynaecologists familiarized themselves with the use of local infiltration, this would lead to better utility of time and help with cost savings. In addition, local anaesthesia not only helps to avoid the well established risks of general anaesthesia but can also be administered to those with medical disorders which contradict the use of a general anaesthetic. A randomized control trial comparing the acceptability of local and general anaesthetic for MEA[24] found that 87% of patients considered local anaesthesia to be acceptable, with no significant difference in post-operative pain, nausea or recovery time.

The safety of this procedure was analyzed as well. The short treatment time (average duration of treatment for the MEA procedure was 3 minutes) and low power (30 watts) required meant that a very low energy dosage (average 4.2 kJ) was used. Serosal temperature measurements showed no change at all stages of treatment and microwave leakage did not occur. The strict check of cavity length (via uterine sounding, cervical dilatation to a size of 9mm Hegar and applicator depth) and the technique of steady applicator withdrawal prevent inadvertent perforation. Continuous thermometry is another important feature. The lack of hysteroscopic fluid and absence of bleeding not only enhance safety, but make it a clean surgical procedure. Our protocol of performing a hysteroscopic assessment before and after the procedure further adds to the safety. We did not report any case of uterine perforation, post operative infection or haemorrhage. The learning curve is extremely short due to the inherent simplicity of the procedure. Moreover, the procedure has been successfully performed under local anaesthesia. In our series, two cases were performed with local infiltration of anaesthesia and did not require more postoperative pain relief compared to the other fourteen cases where general anaesthesia were used. In three cases, there were concomitant surgical procedures. A theoretical risk of developing endometrial cancer has also been suggested, although there is yet any reported cases[11]. Hence, in any patient that has undergone MEA and subsequently experiences the return of menorrhagia or worsening dysmenorrhea, a pelvic ultrasound and endometrial sampling should be performed.

Repeat surgery rates of approximately 10% for patients who have undergone endometrial ablative therapy have been quoted by some authors[12], with most failures being detected after one year of treatment. We did not have any patients who had repeat surgery as one of our treatment failures opted for the Mirena,, one was treated with GnRH analogues and the third had a hysterectomy.

Patient selection plays an important role in the outcome success of Microwave Endometrial Ablation. Efforts should be made to detect adenomyosis pre-operatively as patients with this condition appear to respond poorly and ultimately require a hysterectomy.

Our experience with MEA compares favourably with other larger trials[11]. The procedure is safe, effective and applicable to a majority of women with heavy menstrual bleeding. Our results showed satisfactory outcomes in most of the patients.

One aspect of MEA that requires exploration is its cost effectiveness[25]. In our local setting, a well-designed study into the health economics of MEA would provide us clinicians with important information to further reduce the already escalating health cost to this very common gynaecological condition.

REFERENCES

1. *Bonnar J, Smith SK. Serial and cross-over studies in the treatment of Dysfunctional Uterine Bleeding with Tranexamic Acid, Mefenamic Acid and Ethamsylate. Dysfunctional Uterine Bleeding. London – Royal Society of Medicine Press, 1994:102-103.*

2. *Coulter A, Bradlow J, Agass M et al. Outcomes of referrals to gynaecology clinics for menstrual problems: an audit of general practice records. Br J Obstet Gynaecol 1991;98:789-796.*

3. *MISTLETOE Update. Royal College of Obstetricians and Gynaecologists, Medical Audit Unit;1995.*

4. *Gannon MJ, Holt EM, Fairbank J, Fitzgerald M, Milne MA, Crystal AM, et al. A randomised trial comparing endometrial resection and abdominal hysterectomy for the treatment of menorrhagia. Br Med J 1991;303:1362– 4.*

5. *Sculpher MJ, Bryan S, Dwyer N, Hutton J, Stirrat GM. An economic evaluation of transcervical endometrial resection versus abdominal hysterectomy for the treatment of menorrhagia. Br J Obstet Gynaecol 1993;100:244 – 52.*

6. *Crosignani PG, Vercellini P, Apolone G, De Giorgi O, Cortesi I, Meschia M. Endometrial resection versus vaginal hysterectomy for menorrhagia: Long-term clinical and quality-of-life outcomes. Am J Obstet Gynecol 1997;177: 95–101.*

7. *Lethaby A, Shepperd S, Cooke I, Farquhar C. Endometrial resection and ablation versus hysterectomy for heavy menstrual bleeding (review). Cochrane Database Systematic Rev 2000;2:CD000329.*

8. *O'Connor H, Broadbent JA, Magos AL, McPherson K. Medical Research Council randomised trial of endometrial resection versus hysterectomy in management of menorrhagia. Lancet 1997;349:897–901.*

9. *Pinion SB, Parkin DE, Abramovich DR, Naji A, Alexander DA, Russell IT, et al. Randomised trial of hysterectomy, endometrial laser ablation, and transcervical endometrial resection for dysfunctional uterine bleeding. Br Med J 1994;309:979–83.*

10. *Dwyer N, Hutton J, Stirrat GM. Randomised controlled trial comparing endometrial resection with abdominal hysterectomy for the surgical treatment of menorrhagia. Br J Obstet Gynaecol 1993;100:237– 43.*

11. *Hodgson DA, Feldberg IB, Sharp N, Cronin N, Evans M, Hircowitz L. Microwave endometrial ablation: Development, clinical trials and outcomes at three years. Br J Obstet Gynaecol 1999;106:684 –94.*

12. *Cooper KG, Bain C, Parkin DE. Comparison of microwave endometrial ablation and transcervical resection of the endometrium for heavy menstrual loss. Lancet 1999; 354:1859–63.*

13. *Vessey MP, Villard-Mackintosh L, McPherson K, et al . The epidemiology of hysterectomy: findings in a large cohort study. Br J Obstet Gynaecol 1992;99:402-407.*

14. *HallbergL, Hogdahl AM ,Nilsson L et al. Menstrual blood loss- a population study. Acta Obstet Gynaecol Scand 1966;45:320-351.*

15. *Fraser IS, McCarron G,Markham R. Preliminary study of factors influencing perceptions of menstrual blood loss volume. Am J Obstet Gynaecol 1984;149:788-793*

16. *Lalonde A . Evaluation of surgical options in menorrhagia. Br L Obstet Gynaecol 1994;101(Suppl): 8-14.*

17. *Harkki-Siren, Sjoberg J. Evaluation and learning curve of the first one hundred laparoscopic hysterectomies.Acta Obstet Scand 1995;74:638-641.*

18. *Burke L, Rubin HW, Kim I. Uterine abscess formation secondary to endometrial cryosurgery. Obstet Gynaecol 1973;41:224-226.*

19. *Goldrath MH, Fuller TA, Segal S. Laser photovapourization of the endometrium for the treatment of menorrhagia. Am J Obstet Gynaecol 1981;140:14-19.*

20. *Phipps JH, Lewis BV, Roberts T et al. Treatment of functional menorrhagia by radiofrequency induced thermal endometrial ablation. Lancet1990:335:374-376.*

21. *Overton C, Hargreaves J, Maresh M. A national Survey of Complications of Endometrial Desturction for Menstrual Disorders: The MISTLE Study. Br J Obstet Gynecol 1997;104:1351-1359.*

22. *Scottish Hysteroscopy Audit Group. A Scottish Audit of Hysteroscopic Surgery for Menorrhagia: complications and follow-up. Br J Obstet Gynecol 1995:102;249-254.*

23. *Sharp NC, Cronin N, Feldberg I, et al. Microwaves for menorrhagia; a new fast technique for endometrial ablation. Lancet 1995;346:1003-1004.*

24. *Wallage S, Cooper KG, Graham WJ and Parkin D. A randomized control trial comparing local versus general anaesthesia for MEA. Br J Obstet Gynecol 2003;110:799-807.*

25. *Seymour J, Wallage S, Graham WJ, Parkin D and Cooper K. The cost of microwave endometrial ablation under different anaesthetic and clinical settings. Br J Obstet Gynecol 2003;110:922-926.*