Pregnancy After Hysteroscopic Endometrial Ablation Without Endometrial Preparation: A Report of Five Cases and a Literature Review

Chang-Sheng Yin

Department of Obstetrics and Gynecology, Kang-Ning General Hospital, Taipei, Taiwan.

SUMMARY

Objective: Treating menorrhagia in women of reproductive age by endometrial ablation (EA) decreases menstrual flow and increases quality of life. However, unexpected pregnancy and associated complications are challenges following EA.

Materials and Methods: From January 2000 to March 2008, a total of 356 women aged 26–45 years with persistent menorrhagia underwent total hysteroresectoscopic EA with follow-up at our hospital and were retrospectively evaluated. We also performed a literature search for articles reporting pregnancy after EA published between January 1983 and June 2008.

Results: Overall, 123 pregnancies after EA have been reported in the English literature, including five pregnancies among 356 women who underwent EA at our hospital. Fifty-nine (48%) of 123 pregnancies were terminated at the mother's request. The remaining 64 pregnancies were associated with spontaneous abortion (28%, 17/64), premature rupture of membranes (16%, 10/64), prematurity (31%, 19/64), cesarean section (44%, 27/64), and placental adherence complications (25%, 17/64) which necessitating hysterectomy in 10 women. Four tubal ectopic, two cornual and two cervical ectopic pregnancies were reported. The ectopic pregnancy rate was 6.5% (8/123). There were nine perinatal deaths, corresponding to a perinatal mortality rate of 14% (9/64). Five babies had congenital anomalies, including craniosynostosis (1 case), a set of twins with Down syndrome (1 case), agenesis of the corpus callosum (1 case), bilateral talipes (1 case), and one case of fetal malformation caused by intrauterine synechiae. The only maternal death was a 29-year-old woman with spontaneous rupture of her unscarred uterus and massive intraabdominal hemorrhage at 24 weeks of gestation.

Conclusion: Clinicians must recognize the potential complications associated with pregnancy after EA. Appropriate postoperative contraception and follow-up of menstrual patterns are strongly recommended. [*Taiwan J Obstet Gynecol* 2010;49(3):311–319]

Key Words: endometrial ablation, hysteroscopy, pregnancy

Introduction

Endometrial ablation (EA), which is performed by resectoscopy, use of a thermal balloon, cryotherapy, microwave energy, radiofrequency electrosurgery or exposure to circulated heated liquid, is a highly effective treatment for menorrhagia [1].

Although the short-term success rate is encouraging, the long-term results after EA have yet to be determined. Therefore, careful monitoring of the patient is essential. In particular, intrauterine adhesions and contractures that develop after EA may allow for more aggressive placental invasion or adherence, and make future pregnancy evaluation and management difficult.

Pregnancy after EA is rare, and has a high rate of complications [2–45], including maternal death [46]. Because the true effects of EA on pregnancy outcomes

*Correspondence to: Dr Chang-Sheng Yin, Kang-Ning General Hospital, No. 26, Lane 420, Section 5, Cheng-Kung Road, Taipei 114, Taiwan.
E-mail: khivf@mail.knh.org.tw
Accepted: February 10, 2009

remain unknown, each pregnancy should be reported. Herein we report five pregnancies that occurred after EA among 356 cases treated at our institute, and we reviewed the literature to evaluate pregnancy outcomes and complications.

Materials and Methods

From January 2000 to March 2008, a total of 356 women, aged 26–45 years old with persistent menorrhagia, underwent total hysteroresectoscopic endometrial resection and were included in this study. Endometrial suppression was not used before the procedures. All procedures were conducted through a hysteroscopic resectoscope while the patient was under spinal anesthesia or general anesthesia. The distention fluid was 5% dextrose and was infused using a gravity-feed infusion system. During the surgery, the endometrium (3 mm) was resected and coagulated using a 3-mm rollerball electrode. The operation started with resection of long strips of the endometrium (depth < 3 mm) from the fundus to the low segment using a cutting loop. The rest of endometrium was then coagulated using the rollerball electrode. The generator power was set at 90 W for cutting and 60 W for coagulation.

For women in whom uterine polyps or myomas were found, concomitant resections were done. Submucosal myoma resections were carried out using unipolar cutting-loop resection techniques. All of the resected endometrial strips, myomatous fragments and polyps were sent for histological evaluation. During EA the surgeon ensured that no endometrial tissue was left *in situ*.

All procedures were completed safely; however, two women sustained uterine perforation and underwent hysterectomies. In a third woman, the procedure was abandoned because of suspected endometrial malignancy. None of the patients showed any signs or symptoms of fluid overload or hyponatremia. All patients were monitored for postoperative morbidity at 1 week and 1 month after surgery, then every 6 months by telephone, mail or at our clinics.

Patient satisfaction was assessed with the question "How satisfied or dissatisfied are you with the result of surgery related to menstrual flow and dysmenorrhea?" Patients rated their overall satisfaction on a 4-point scale (1 = very satisfied, 2 = satisfied, 3 = dissatisfied, 4 = very dissatisfied). The need for repeat surgery or hysterectomy was also reported.

We performed a literature search in MEDLINE with a date range from January 1, 1983 to August 30, 2008, using the keywords "pregnancy", "endometrial ablation", and "hysteroscopy", to identity potentially eligible case reports and cross-referenced articles.

Results

A total of 334 women (94%) were eligible for follow-up after surgery. The follow-up duration ranged from 7 months to 109 months (mean = 48.7 months). Twenty-two women were lost to follow up. Among the 334 women who were successfully followed-up after EA, 161 (48%) had normal flow, 33 (10%) had hypomenorrhea, 31 (9%) had heavy flow, and 82 (25%) continued to have amenorrhea. Seventeen (5%) women were unsatisfied with the results and seven received hysterectomies because of EA failure. Ten women (3%) underwent EA again.

During the follow-up period, five pregnancies occurred after the procedure, and the mean age of these women was 36 years (range, 34–40 years). The outcomes of the five pregnancies are shown in Tables 1 and 2 [2–46]. Of the five patients who conceived after surgery, two patients had normal flow and three patients had hypomenorrhea. Two pregnancies resulted in spontaneous miscarriages that were managed by suction curettage. One pregnancy was terminated at the mother's request by oral mifipristone. The other two illustrated cases are described in more detail below.

Case 1

A 34-year-old woman at 12 weeks gestation opted to terminate her pregnancy. At age of 32, she underwent hysteroscopic EA at our hospital. After EA the patient experienced light menses. Surgical termination of the pregnancy at a local gynecology clinic failed because of severe fibrosis involving the lower uterine cavity, which rendered sounding and dilation impossible. The patient was then transferred to our hospital where hysterotomy and bilateral tubal sterilization were performed. A fetus at 12 weeks of gestation was found in the left horn of the uterus, and the obliterated lower uterine cavity was found during operation. After the operation, she continued to experience a light period.

Case 2

A 36-year-old woman, gravida 3, para 2, presented at our emergency room at 22 weeks of gestation with preterm premature rupture of membranes. She had two prior full term vaginal deliveries without complications. Eight months before the current pregnancy, she had undergone hysteroscopic endometrial resection for menorrhagia and dysmenorrhea.

Table 1. Pregnancy less than 20 weeks ($n = 86$)

Author	Year	Age at surgery (yr)	Latent period*	Methods	Mode of delivery	Gestation (wk)
Mongelli & Evans [2]	1991	39	18 mo (amenorrhea)	TCRE	TOP	12 (adenomyosis)
Magos et al [3]	1991	NA	7 mo (normal flow)	TCRE	TOP	NA
Gannon et al [4]	1991	38	NA (normal flow)	TCRE	TOP	NA
Lam et al [5]	1992	38	6 mo (amenorrhea)	TCRE	Ectopic/operated	NA
Whitelaw et al [6]	1992	NA	12 mo	NA	Spont ab	12
		NA	6 mo	TCRE	TOP/hysterectomy	12
		NA		NA	TOP (16 cases)	NA
Goldberg [7]	1994	37	4 mo (light)	Ablation (rollerball)	Spont ab	7
Garry et al [8]	1995	NA	NA	Ablation (laser)	TOP	12
Nicholson et al [9]	1995	NA	NA	TCRE	TOP	13
		NA	NA	TCRE	TOP	13
Mc Lucas [10]	1995	38	36 mo (light)	Ablation (rollerball)	Spont ab (TOP)	6
Browne [11]	1996	NA	NA	TCRE/ablation	TOP	NA
Rogerson et al [12]	1997	33	4 yr (light)	TCRE	Spont ab/ + subtotal hysterectomy	19 (PPROM, placenta accreta)
		38	3 mo & 2 yr (light)	Ablation (rollerball)	Spont ab × 2 pregnancies	7 & 6 (same patient)
Carpenter et al [13]	1998	40	8 mo (light)	TCRE	Spont ab	17 (1st pregnancy)
Mints et al [14]	1998	NA	NA	TCRE	Spont ab	NA
Gervaise et al [15]	1999	NA	18 mo (NA)	Thermal/balloon	Spont ab	10
Cravello et al [16]	2001	36	18 mo (light)	Thermal/balloon	TOP	8
Cook & Seman [17]	2003	32	3 yr (light)	Ablation	Spont ab	6 (2nd pregnancy)
El-Toukhy & Hefni [18]	2003	34	16 mo (light)	Hydrothermal	Spont ab	9
Hare & Olah [19]	2005	36	24 mo	Ablation (laser)	Spont ab	8
Gandhi & Habiba [20]	2005	46	6 mo (amenorrhea)	Thermal/balloon	Ectopic/operated	NA
Lo & Pickerzgill [21]	2006	39	4 mo (amenorrhea)	Microwave	TOP	12
Xia et al [22]	2007	NA	NA	TCRE	Operated/tubal ectopic × 2	NA
		NA	NA	TCRE	Operated/corneal/hysterectomy × 2	NA
		NA	5 yr	TCRE	1 cervical pregnancy/TOP/Foley balloon tamponade	NA
		NA	NA	TCRE	Spont ab	NA
				TCRE	Hysteroscopic adhesiolysis/TOP	NA
				TCRE	TOP/Foley balloon tamponade	NA
				TCRE	TOP (30 cases)	NA
Giarenis et al [23]	2007	39	5 yr (NA)	Ablation (balloon)	Cervical pregnancy/MTX	
Palep-Singh et al [24]	2007	39	24 mo (amenorrhea)	MEA	Failed TOP/MTX	6
Laberge [46]	2008	34	10 mo (light)	TCRE/ablation	Failed TOP/hysterectomy	5
Present study		40	8 mo (light)	TCRE/ablation	Spont ab/TOP	9
		35	41 mo (light)	TCRE/ablation	Spont ab/TOP	8
		34	19 mo (light)	TCRE/ablation	TOP	6
		34	21 mo (light)	TCRE/ablation	Lt horn pregnancy/failed TOP/hysterectomy + T/S Bil	12

**Interval between ablation and conception. TCRE = transcervical resection of endometrium; TOP = termination of pregnancy; NA = not available; spont ab = spontaneous abortion; PPROM = preterm premature rupture of membranes; MTX = methotrexate; T/S = tubal sterilization; MEA = microwave endometrial ablation.*

Table 2. Pregnancy outcomes beyond 20 weeks ($n=37$)

Author	Year	Age at surgery (yr)	Latent period (menses)*	Method of ablation or TCRE	Pregnancy complications	Gestation (wk)	Mode of delivery	Birth weight (g)	Outcome	Placentation
Hill & Maher [25]	1992	35	5 mo (spotting)	TCRE ablation	Normal	39	CS (elective + T/S) (Filshie clips)	3,380	Alive & well	Normal
Whitlaw et al [6]	1992	44	11 mo (light)	Ablation (laser)	IUGR, PIH Breech	39	CS	2,520	Craniosynostosis hearing loss	Normal
		31	14 mo (amenorrhea)	Ablation (laser)	Breech	39	CS	3,578	Alive & well	Normal
		32	6 mo (NA)	Ablation (laser)	IUGR	31	CS	1,100	Live birth	Placenta increta
		39	NA	Ablation (laser)	Fetal distress	34	CS/hysterectomy	1,245	Live birth	Placenta accreta
		41	NA	Ablation (laser)	IUGR, PTL	29	CS	950	Live birth	Adherent placenta
Wood & Rogers [26]	1993	30	6 mo (light)	Partial TCRE	PPROM (22 wk)	28	CS (classic)	1,154	Died at 32 hr	Partial accreta
Maouris [27]	1994	33	6 mo (amenorrhea)	TCRE	PPROM (30 wk)	30	CS (oblique lie)	1,700	Alive & well	Adherent placenta
Hopkisson et al [28]	1994	25	24 mo (menorrhagia 6 mo)	TCRE	IUFD, PPH	31	CS (classic)/ hysterectomy	1,200	Macerated	Normal
Kirby et al [29]	1994	41	18 mo (light)	TCRE	Fetal tachycardia	38	CS	2,640	Alive & well	Normal
		32	4 mo (amenorrhea)	TCRE	Normal	39	VD	3,870	Alive & well	Normal
Garry et al [8]	1995	NA	NA	Ablation (laser)	Breech	39	CS	3,810	Alive & well	Normal
Nicholson et al [9]	1995	NA	NA	TCRE	IUFD	28	CS/hysterectomy	NA	Stillbirth	NA
Vilos et al [29]	1995	30	6 mo (light)	Rollerball	PPROM	22	Abortion	375	Neonatal death	NA
Edwards et al [31]	1996	33	24 mo (light)	TCRE	Normal	40	VD	3,735	Alive & well	Normal
Cater & Lindsay [32]	1997	NA	4 mo (NA)		IUFD	36	VD (1st pregnancy)	2,050	Macerated	Adherent placenta
			10 mo (NA)	Rollerball	Normal	40	CS (2nd pregnancy)	2,950	Alive & well	Normal, same patient
Rogerson et al [12]	1997	31	7 yr (light)	Rollerball	PPROM	35	VD	1,900	Alive & well	Adherent placenta
Oppermam et al [33]	1998	40	33 mo (light)	Rollerball	–	38	CS	3,650	Alive & well	Normal
Ismail et al [34]	1998	38	26 mo (amenorrhea)	Rollerball	–	38	VD	3,200	Alive & well	Normal
Carpenter et al [13]	1998	40	20 mo (normal)	TCRE	APH	34	CS (2nd pregnancy)	2,560	Alive & well	Total placenta previa
Brown [35]	1999	35	24 mo (light)	Rollerball	PROM	37	CS (transverse lie)	2,900	Alive & well	Adherent placenta
Pugh et al [36]	2000	29	16 mo (normal)	Rollerball	Transverse lie	38	Classical CS	3,095	Alive & well	Normal
Langdana & Mundow [37]	2000	29	6 mo (light)	Rollerball	IUGR	34	CS	1,515	Alive & well	Normal
Pinett et al [38]	2001	26	12 yr (normal)	Ablation (laser)	Nil	38	CS	2,846	Alive & well	Normal
Abdel-Fattah et al [39]	2003	40	5 mo (normal)	TCRE	Twin (IUGR)	35	CS	NA	Down's (both)	Normal
Cook & Seman [17]	2003	32	6 yr (light)	Rollerball	PROM (38 wk)	38	VD (1st pregnancy)	3,495	Alive & well	Normal

Hoffman & Sciscione [40]	2004	38	3 yr (normal)	TCRE+ myomectomy	IUFD (20 wk)	20	VD/hysterectomy	349	Macerated, bil talipes	Placenta accreta
Kir & Hanlon-Lundberg [41]	2004	38	11 mo (light)	Thermal balloon	Premature	35	VD	3,000	Agenesis of the corpus callosum	Normal
Hare & Olah [19]	2005	36	6 yr (light)	Ablation (laser)	Breech	38	CS	3,860	Alive & well	Normal
Makul & Linn [42]	2005	27	7 yr (NA)	Rollerball	PPROM (26 wk)	26	CS/hysterectomy	796	Died at 6 hr, amniotic band deformity	Adherent placenta
Xia et al [22]	2006	NA	NA	TCRE	Normal	39	CS/hysterectomy	2,500	Alive & well	Placenta increta
Hamar et al [43]	2007	29	2 yr (amenorrhea)	Thermal balloon	PPROM (35 wk)	35	CS/hysterectomy	2,050	Alive & well	Placenta increta
Foote et al [44]	2007	43	4 mo (normal)	Thermal balloon + Embolization	Fetal distress	35	CS	2,466	Alive & well	Normal
Patni et al [45]	2008	36	4 yr	TCRE	PPROM (33 wk)	34	CS/hysterectomy	2,340	Alive & well	Placenta increta
Laberge [46]	2008	25	5 yr (light)	TCRE	Rupture uterus		IUFD	NA	Maternal death	NA
Present study		34	8 mo (light)	TCRE ablation	PPROM (22 wk)	33	CS/hysterectomy	2,060	Neonatal death pulhypoplasia	Placenta increta

**Interval between ablation and conception. TCRE = transcervical resection of endometrium; CS = cesarean section; T/S = tubal sterilization; IUGR = intrauterine growth retardation; PIH = pregnancy-induced hypertension; NA = not available; PTL = preterm-laber; PPROM = preterm premature rupture of membranes; IUFD = intrauterine fetal death; PPH = post-partum hemorrhage; VD = vaginal delivery; APH = Ante partum hemorrhage; PROM = premature rupture of membranes.*

After the surgery the patient had been hypomenorrheic, but with persistent dysmenorrhea. Upon admission she underwent tocolysis for 48 hours, and was treated with ampicillin for 7 days. There were no labor pains, but continued leakage of amniotic fluid was noted. The patient declined to terminate the pregnancy after detailed discussion regarding infection, prematurity, and other potential complications of pregnancy. She rested in the hospital for the next 10 weeks. During this time there was persistent loss of amniotic fluid with oligohydramnios. At 33 weeks, she developed a fever, fundal tenderness, and clinical suspicion of chorioamnionitis. A cesarean section delivery was performed, and a 2,060 g female baby with Apgar scores of 1 and 3 was delivered. During the cesarean section, the placenta failed to separate. A diagnosis of placenta increta was made and a supra-cervical hysterectomy was performed. The postoperative course was uneventful. The pathologic examination of the uterus and placenta showed placenta increta. Unfortunately, the baby died after 3 days because of pulmonary hypoplasia.

Literature review

Overall, 123 pregnancies after EA have been reported in the English literature [2–46], including the five pregnancies reported in this paper. The outcomes are presented in Tables 1 and 2. This literature review revealed that the mean age at surgery was 36 years (range, 25–46 years) and the time between surgery and conception ranged from 3 months [13] to 12 years [38], with a mean duration of 25 months. The recorded menstrual pattern at the time of pregnancy in 47 of the 123 women showed hypomenorrhea in 27 cases (56%), amenorrhea in 10 (21%), eumenorrhea in nine (19%), and menorrhagia in one (2%).

Of the 123 pregnancies after EA, a total of 83 (67%) were terminated before 20 weeks. Fifty-nine (48%) of the pregnancies were successfully terminated at the mother's request. The remaining 64 pregnancies were associated with multiple complications including spontaneous abortion (27%, 17/64), premature rupture of membranes (16%, 10/64), premature birth (30%, 19/64), cesarean sections (42%, 27/64) and placental adherent complications (25%, 15/64). Of the 17 women with placental adherent complications, cesarean hysterectomy was necessary in eight patients [6,12,23, 42,43,45,46] including two of our cases. Four tubal ectopic pregnancies [5,20,22], two cornual ectopic pregnancies [22] and two cervical ectopic pregnancies [22,23] were reported, yielding an ectopic pregnancy rate of 7% (8/120). Both cornual ectopic pregnancies underwent subtotal hysterectomy [22]. Of the two cervical pregnancies, one underwent cervical curettage

with a Foley's balloon tamponade [22], while the other was treated with two doses of intramuscular methotrexate [23]. There were eight perinatal deaths including four intrauterine deaths and four neonatal deaths. The perinatal mortality rate was 13%. The only maternal death was a 29-year-old woman who died 5 years after EA. At 24 weeks of gestation, she experienced sudden rupture of unscarred uterus and massive intra-abdominal bleeding, and died because of hemorrhagic shock [46].

There were five babies with congenital anomalies out of 36 pregnancies that progressed beyond 20 weeks of gestation, including a 2,520 g baby with craniosynostosis and hearing loss born to a 44-year-old woman [6], a set of twins with Down syndrome born at 35 weeks of gestation to a 40-year-old woman [39], an intrauterine death at 20 weeks with bilateral talipes [40], one case of agenesis of the corpus callosum [41], and an amniotic band deformity in a neonatal 796 g baby, who was born at 26 weeks of gestation [42]. There were four intrauterine deaths that occurred at 20, 28, 31, and 36 weeks respectively, including the above mentioned fetus with bilateral talipes [9,28,32,40].

There were four neonatal deaths, two with severe prematurity (1,154 g and 375 g) [26,30], one with prematurity (796 g) and amniotic band syndrome (as mentioned above) [42], and one (2,060 g) with pulmonary hypoplasia (case 2 in the present study). Of the 36 pregnancies after EA that continued beyond 20 weeks, only 28 (78%) resulted in surviving infants.

Four women became pregnant twice after EA. One woman aborted both of her pregnancies (at 7 and 6 weeks of gestation) [12]; the other three women each had one spontaneous abortion and one term live birth [13,17,32].

Discussion

In 1991, a case of pregnancy after EA was reported while the first maternal death reported in 2008 [46] and the serious adverse events summarized here illustrate the risk of pregnancies after EA. The pregnancy rate after EA is 0.24–0.68% [17,18,36], and was 1.4% in our series, representing a new clinical entity with diagnostic and management challenges. As in Asherman's syndrome, significant intrauterine adhesions and contractures may allow for aggressive placental invasion or adherence. Poor obstetric outcomes have been reported for Asherman's syndrome and for pregnancy after EA [17,47], while half of the pregnancies after EA summarized in this literature review were terminated at the mother's request.

There is still limited information on the uterine assessment of women who become pregnant after EA. However, a positive correlation between normality of the uterine cavity and the subsequent outcome of the pregnancy has been reported [17]. Hysteroscopy is the gold-standard diagnostic method for intrauterine adhesions; however, routine use of hysteroscopy for all women of reproductive age after EA is not advised. Hysterosalpingography is a relatively inexpensive office procedure. It is the best diagnostic test for evaluating the fallopian tubes. It also provides detailed information about the uterine cavity contour, and the region of the internal os. Currently, the two most useful classification systems for intrauterine scarring in Asherman's syndrome are the European Society Hysteroscopy system [48] and the American Society for Reproductive Medicine scoring system [49]. However, neither system can completely predict outcomes. Transvaginal ultrasound plus saline sonohysterography performed during the periovulatory phase is the best approach to evaluate the uterine cavity contours.

In hypomenorrheic and amenorrheic women, who represent about 78% of the reported post-EA pregnancies, pregnancy must be confirmed by reviewing the case history, ultrasound and serum β-HCG measurement to confirm viable intrauterine pregnancy and to assess gestational age. During pregnancy, serial ultrasound scans should be performed to check fetal growth and abnormal placentation. In women who choose to terminate a pregnancy, preoperative counseling and ultrasound examination are necessary. They should also be counseled about the possibility of failed curettage due to severe adhesion of the cavity, and the need for a hysterotomy or possibly a hysterectomy. There are some reports regarding medical abortions in women with scarred, irregular cavities [50,51].

Surgical curettage was difficult in four of the women in this case series. Palep-Singh et al [24] reported a pregnancy after microwave ablation, after failure of standard medical management and surgical evacuation. The patient was then given a single intramuscular dose (50 mg/m^2) of methotrexate. The patient experienced vaginal bleeding 1 week later and a transvaginal scan showed no gestational sac 3 weeks after the injection. Xia et al [22] reported a successful termination of pregnancy after hysteroscopic adhesiolysis in a woman with an obliterated lower uterine segment. They reported another case in whom 700 mL of heavy arterial bleeding occurred after suction curettage. The bleeding was controlled by the insertion of a Foley balloon to tampon the cavity [22]. As in Case 1 described above, the obstructed lower segment made it difficult to pass the uterine sound, resulting in failed surgical abortion.

Abnormal placental adherence was found in 16 women, which necessitated hysterectomies in nine (56%) pregnancies. The most common predisposing factor is previous uterine surgery, such as cesarean section, myomectomy, curettage or EA. If the invasion is not detected antenatally, the patient can experience massive hemorrhage. Unfortunately, placenta accreta is not easily detected by antenatal ultrasound, as in Case 2 described above, and as reported by Hamar et al [43] and Patni et al [45]. Hamar et al hypothesized that the placenta was adhered to an abnormal uterine lining with limited focal placental invasion. Therefore, the sonographic findings may differ from those associated with classic placenta accreta, which include visualization of irregular vascular spaces within the placenta (placental lacunae), bladder–uterine serosa interphase hypervascularity, prominent subplacental venous complexes, and the absence of an echolucent area between the placenta and myometrium [43]. Patni et al reported a similar case of placenta increta that a 40-year-old woman, who was pregnant at 30 weeks of gestation, experienced a preterm premature rupture of membranes at 33 weeks of gestation 4 years after TCRE. The ultrasound examination revealed an anterior placenta spread over the entire anterior wall like a thin sheet, and an indistinct uteroplacenta interface [45]. Color Doppler scanning has been used to detect placenta accreta with a reported sensitivity of 82% and a negative predictive value of 95% to diagnose placenta accreta [52]. Magnetic resonance imaging may complement ultrasound in the diagnosis of placenta accreta, increta, or percreta. Magnetic resonance imaging is usually performed during the second or third trimester because of theoretical safety concerns regarding tissue overheating by radiofrequency pulses.

There were five congenital anomalies reported in this series, but only Mukul and Linn [42] reported a case with fetal malformations and neonatal death caused by intrauterine synechiae after EA. The male infant had positional deformities in the neck, an asymmetrical chest, severe scoliosis, bilateral clubbed feet with extremity arthrogryposis. An amniotic band constriction was found on the right leg, causing significant ischemia and necrosis [42]. Other anomalies such as craniosynostosis in a term 2,520 g baby [6], a set of twins with Down syndrome born to a 40-year-old mother [39], a 349 g stillbirth with bilateral talipes [40], and a preterm 3,000 g baby with agenesis of the corpus callosum [41] have also been reported. However, these rare fetal anomalies affecting pregnancies after EA are probably coincidental.

The current total or global EA procedures cause significant intrauterine adhesion and contractures, and are associated with long-term adverse effects, which include painful central hematometra, cornual hematometra, and postablation tubal sterilization syndrome in patients with tubal ligation [53]. Postablation tubal sterilization syndrome consists of painful hematosalinges, resulting from active endometrial tissue near the cornual region and endometrial scarring and contractures that prevent menstrual egress. A partial rollerball ablation procedure in which only one (anterior or posterior) wall is resected and ablated was proposed to prevent intrauterine scarring and contractures, and thus avoid such complications [54,55]. This approach allows the normal endometrial surface to oppose the injured exposed myometrial surface, so that adhesions and contractures do not occur. To date, there has been only one report of a pregnancy after partial EA. This pregnancy only proceeded to 28 weeks of gestation, and does not yet show potential benefits for women wishing to retain fertility [27].

Since EA has become a popular treatment for menorrhagia, more women of reproductive age may have undergone this procedure with a variety of technologies. It is essential that contraceptive measures are implemented for all patients after EA, unless the women reaches menopause or has confirmed tubal obstruction. A newly developed hysteroscopic tubal occlusion microinsert device, Essure (Conceptus, San Carlos, CA, USA), can be used by physicians with experience in operative hysteroscopy. However, the use of this device concomitantly with a microinsert device for hysteroscopic sterilization during EA is not recommended. Except for balloon EA, no electrosurgical procedures, microwave, or radiofrequency EA should be performed after insertion of a hysteroscopic microinsert device [56].

Many pregnancies after EA are incomplete and are underreported; therefore, an international registry study to record more case reports is suggested.

In summary, pregnancy after EA is associated with an increased rate of maternal complications and perinatal mortality. Clinicians must recognize the potential complications and offer appropriate preoperative counseling and postoperative contraception with continued follow-up.

References

1. Zarek S, Sharp HT. Global endometrial ablation devices. *Clin Obstet Gynecol* 2008;51:167–75.
2. Mongelli JM, Evans AJ. Pregnancy after endometrial resection (letter). *Lancet* 1991;338:578–9.
3. Magos AL, Baumann R, Gill ML, et al. Experience with the first 250 endometrial resections for menorrhagia. *Lancet* 1991;337:1074–8.

4. Gannon MJ, Holt EM, Fairbank J, et al. A randomized trial comparing endometrial resection and abdominal hysterectomy for the treatment of menorrhagia. *BMJ* 1991;303: 1362–4.
5. Lam AM, Al-Jumaily RY, Holt EM. Ruptured ectopic pregnancy in an amenorrhoeic woman after transcervical resection of the endometrium. *Aust N Z J Obstet Gynecol* 1992;32:81–2.
6. Whitelaw NL, Garry R, Sutton CJG. Pregnancy following endometrial ablation: 2 case reports. *Gynaecol Endosc* 1992; 1:129–32.
7. Goldberg IM. Intrauterine pregnancy following endometrial ablation. *Obstet Gynecol* 1994;83:836–7.
8. Garry R, Shelly-Jones D, Mooney P, et al. Six hundred endometrial laser ablations. *Obstet Gynecol* 1995;85:24–9.
9. Nicholson SC, Slade RJ, Ahmed AJH, et al. Endometrial resection in Oxford: the first 500 cases—a 5 year follow up. *J Obstet Gynecol* 1995;15:38–43.
10. McLucas B. Pregnancy after endometrial ablation: a case report. *J Reprod Med* 1995;40:237–9.
11. Browne DS. Endometrial resection: a comparison of techniques. *Aust N Z J Obstet Gynaecol* 1996;36:448–52.
12. Rogerson L, Gannon MJ, O'Donovan J. Outcome of pregnancy following endometrial ablation. *J Gynecol Surg* 1997; 13:155–60.
13. Carpenter T, Smith P, Penman D. Successful second pregnancy following transcervical endometrial resection. *J Obstet Gynecol* 1998;18:480.
14. Mints M, Radestad A, Rylander E. Follow up of hysteroscopic surgery for menorrhagia. *Acta Obstet Gynecol Scand* 1998;77:435–8.
15. Gervaise A, Fernandez H, Capella-Allouc S, et al. Thermal balloon ablation versus endometrial resection for the treatment of abnormal uterine bleeding. *Hum Reprod* 1999;14:2743–7.
16. Cravello L, Agostini A, Roger V. Intrauterine pregnancy after thermal balloon ablation. *Acta Obstet Gynecol Scand* 2001; 80:671.
17. Cook JR, Seman EI. Pregnancy following endometrial ablation: case history and literature review. *Obstet Gynecol Surv* 2003; 58:551–6.
18. El-Toukhy T. Hefni M. Pregnancy after hydrothermal endometrial ablation and laparoscopic sterilization. *Eur J Obstet Gynecol Reprod Biol* 2003;106:222–4.
19. Hare AA, Olah KS. Pregnancy following endometrial ablation: a review article. *J Obstet Gynecol* 2005;25:108–14.
20. Gandhi SV, Habiba MA. Ectopic pregnancy presenting as haematometra following Cavaterm™ balloon endometrial ablation. *J Obstet Gynaecol* 2005;25:614–5.
21. Lo JSY, Pickerzgill A. Pregnancy after endometrial ablation: English literature review and case report. *J Minim Invasive Gynecol* 2006;13:88–91.
22. Xia E, Li TC, Yu D, Huang X, Zheng J, Liu Y, Zhang M. The occurrence and outcome of 39 pregnancies after 1621 cases of transcervical resection of endometrium. *Hum Reprod* 2006; 21:3282–6.
23. Giarenis I, Shenoy J, Morris E. Cervical ectopic pregnancy after endometrial ablation: a case report. *Arch Gynecol Obstet* 2007;277:567–9.
24. Palep-Singh M, Angela P, Seela R, Mathuv R. Impact of microwave endometrial ablation in the management of subsequent. *J Minim Invasive Gynecol* 2007;14:365–6.
25. Hill DJ, Maher PJ. Pregnancy following endometrial ablation. *Gynaecol Endosc* 1992;1:47–9.
26. Wood C, Rogers P. A pregnancy after planned partial endometrial resection. *Aust N Z J Obstet Gynaecol* 1993;33: 316–8.
27. Maouris P. Pregnancy after planned partial endometrial resection. *Aust N Z J Obstet Gynaecol* 1994;34:122–3.
28. Hopkisson JF, Kennedy SH, Ellis JD. Caesarean hysterectomy for intrauterine death after failed endometrial resection. *Br J Obstet Gynaecol* 1994;101:810–1.
29. Kirby M, Clubb AW, O'Brien PMS. Pregnancy following endometrial resection. *J Obstet Gynecol* 1994;14:17–8.
30. Vilos GA. Intrauterine pregnancy following rollerball endometrial ablation. *J SOGC* 1995;17:479–80.
31. Edwards A, Tippett C, Lawrence M, et al. Pregnancy outcome following endometrial ablation. *Gynaecol Endosc* 1996;5: 349–51.
32. Carter K, Lindsay PC. A stillbirth and a successful pregnancy following endometrial ablation: a case report. *Gynaecol Endosc* 1997;6(suppl):92.
33. Opperman J, Browning D, Child A, et al. Pregnancy following rollerball endometrial ablation. *Gynaecol Endosc* 1998;7:3–7.
34. Ismail MS, Torsten U, Serour GL, et al. Is endometrial ablation a safe contraceptive method? Pregnancy following endometrial ablation. *Eur J Contracept Reprod Health Care* 1998; 3:99–102.
35. Brown O. Pregnancy following endometrial ablation. *J Obstet Gynecol* 1999;19:563.
36. Pugh CP, Crane JM, Hogan TG. Successful intrauterine pregnancy after endometrial ablation. *J Am Assoc Gynecol Laparosc* 2000;7:391–4.
37. Langdana F, Mundow L. Pregnancy following endometrial ablation. *J Obstet Gynecol* 2000;20:90.
38. Pinette M, Katz W, Drouin M, et al. Successful planned pregnancy following endometrial ablation with the YAG laser. *Am J Obstet Gynecol* 2001;185:242–3.
39. Abdel-Fattah MS, White D, Barrington JW. Twin Down syndrome babies: the outcome of a pregnancy following endometrial resection. *Obstet Gynecol* 2003;23:436–8.
40. Hoffman MK, Sciscione AC. Placenta accreta and intrauterine fetal death in a woman with prior endometrial ablation. *J Reprod Med* 2004;49:384–6.
41. Kir M, Hanlon-Lundberg KM. Successful pregnancy after thermal balloon endometrial ablation. *Obstet Gynecol* 2004; 103:1070–3.
42. Mukul LV, Linn JG. Pregnancy complicated by uterine synechiae after endometrial ablation. *Obstet Gynecol* 2005;105: 1179–82.
43. Hamar BD, Woff ERF, Kodaman PH, Marcovici I. Premature rupture of membranes, placenta increta, and hysterectomy in a pregnancy following endometrial ablation. *J Perinatol* 2006;26:135–7.
44. Foote M, Rouse A, Gil KM, Crane S, Lavin JP. Successful pregnancy following both endometrial ablation and uterine artery embolization. *Fertil Steril* 2007;88:1676e15–7.
45. Patni S, El Garib M, Majb HS, Edwards GJ, Ashraf MA. Endometrial resection mandates reliable contraception thereafter—a case report of placenta increta following endometrial ablation. *Eur J Contracept Reprod Health Care* 2008; 13:208–11.

46. Laberge PY. Serious and deadly complications from pregnancy after endometrial ablation: two case reports and review of the literature. *J Gynecol Obstet Biol Reprod (Paris)* 2008; 37:609–13.
47. Friedman A, Defazio J, DeCherney A. Severe obstetric complications after aggressive treatment of Asherman syndrome. *Obstet Gynecol* 1986;67:864–7.
48. Wamsteker K, De Blok ST. Diagnostic hysteroscopy: technique and documentation In Sutton C, Diamond M, eds. *Endoscopic Surgery for the Gynecologist*. New York: Lippincott Williams and Wilkins, 1995;262–76.
49. American Fertility Society. The American Fertility Society classification of adnexal adhesions, distal tubal occlusion, tubal occlusion secondary to tubal ligation, tubal pregnancies, Müllerian anomalies, and intrauterine adhesions. *Fertil Steril* 1988;49:944–55.
50. Li YT, Kuo TC, Chen FM, Chu YC, Hou SC. Mifepristone and misoprotol induced abortion with a large myomatous uterus. *Taiwan J Obstet Gynecol* 2005;44:175–6.
51. Chen BA, Reeves MF, Creinin MD, Gilles JM, Barnhant K, Westhott C, Zhang J. Misoprostol for treatment of early pregnancy failure in women with previous uterine surgery. *Am J Obstet Gynecol* 2008;198:626.e1–5.
52. Chou MM, Ho ES, Lee YH. Prenatal diagnosis of placenta previa, acreta by transabdominal color Doppler ultrasound. *Ultrasound Obstet Gynecol* 2000;15:28–35.
53. Turnbull L, Bowsley SJ, Horsman A. Magnetic resonance imaging of the uterus after endometrial resection. *Br J Obstet Gynaecol* 1997;104:934–8.
54. McCausland AM, McCausland VM. Partial rollerball endometrial ablation: a modification of total ablation to treat menorrhagia without causing complications from intrauterine adhesions. *Am J Obstet Gynecol* 1999;180: 1512–21.
55. McCausland AM, McCausland VM. Frequency of symptomatic corneal hematometra and postablation tubal sterilization syndrome after total rollerball endometrial ablation: a 10-year follow-up. *Am J Obstet Gynecol* 2002; 186:1274–84.
56. Bradley LD. Hysteroscopic sterilization. In: Bradley LD, Falconet, eds. *Hysteroscopy: Office Evaluation and Management of the Uterine Cavity*. Philadelphia: Mosby, 2009;187–99.