2015: the year of cesarean scar pregnancy.

HIFU and new perspectives

Dott. Emanuele Ancona


Cesarean section ectopic pregnancy (CSEP) occurs when an early pregnancy (blastocyst) implants on myometrial tissue from an existing cesarean section scar.

If unrecognized and allowed to develop and grow devastating complications:
- Placental abnormalities (accreta)
- Catastrophic life-threatening maternal hemorrhage
- Uterine rupture

Type I
Implantation of a gestational sac in the existing scar with growth toward the uterine cavity.

Qian ZD. Fertil Steril. 2014 Jul;102(1):129-134
Ectopic Pregnancy within a Cesarean Scar Resulting In Live Birth: A Case Report

Firoozeh Ahmadi MD1, Deena Moinian MSc1, Parichehr Pooransari MD1, Zohreh Rashidi BSc1, Hadieh Haghighi BSc1

At 38 weeks, the baby was safely delivered during a three-hour long cesarean section operation. A placenta previa and 30% placenta accrete was observed. After delivery, the placenta was stuck to the lower segment which caused bleeding. Despite the efforts made to control the bleeding, a hysterectomy was performed. The fully extracted placenta was transferred to the pathology laboratory for further study. The patient had an uneventful postoperative recovery and was discharged from the hospital on postoperative day 3.

Ahmadi F, 2013 Nov;16(11):679-82
Type II

Deep implantation into the scar defect with growth towards the myometrium, the uterine serosal layer and the bladder

High risk of uterine rupture and uncontrolled hemorrhage

Qian ZD. Fertil Steril. 2014 Jul;102(1):129-134
Incidence

1:2,216

6.1% of ectopic pregnancies

- Increased rate of cesarean delivery (50% in China)
- Transvaginal color Doppler sonography diagnosis

Qian ZD. Fertil Steril. 2014 Jul;102(1):129-134
Risk factors

• Cesarean delivery history in rural community hospitals (China)
• Earlier cesarean scar pregnancy
• Repeated cesarean scar pregnancies
• Earlier surgeries (cesarean delivery or Myomectomy)
• Brief interval between the surgery and subsequent conception.

Qian ZD. Fertil Steril. 2014 Jul;102(1):129-134
Timing of previous cesarean section

• Elective cesarean section: Isthmic scar and reduced risk of vesical adherences

• Cesarean section during labour/dilatative phase: cervical/low scar with high risk of adherences

Maymon R Hum Reprod Update. 2004 Nov-Dec;10(6):515-23
Qian ZD. Fertil Steril. 2014 Jul;102(1):129-134
**Etiology**

Invasion of the myometrium through a microscopic tract that develops from the trauma of earlier uterine surgery, such as curettage, CS, or myomectomy.

- Scar has a deleterious effect on decidualization
- The scar surface is increased after repeated cesarean sections and the anterior uterine wall may be deficient because of poor vascularity, fibrosis, and impaired healing

Qian ZD. Fertil Steril. 2014 Jul;102(1):129-134
Symptoms

- Vaginal bleeding
- Spotting
- Pain or cramping
- Asymptomatic

- Occasional finding during gestational age scanning

1. Endometrial and endocervical canal devoid of a pregnancy
2. Placenta/gestational sac embedded in the hysterotomy scar
3. Triangular gestational sac that fills the niche of the scar
4. A thin (1–3 mm) or absent myometrial layer between the gestational sac and bladder
5. Embryonic/fetal pole with or without heart activity;
6. Prominent and at times rich vascular pattern at or in the area of a cesarean delivery scar
7. All of the above in the presence of positive human chorionic gonadotropin (hCG) levels.
The gestational sac is implanted on the cesarean section scar (arrow) in the anterior LUS, with thinned myometrium (M) anteriorly and an empty endometrial cavity (EC).
Eccentrically located gestational sac in the LUS in close proximity to the bladder, causing a bulge in the uterine contour at the scar

A yolk sac and embryo are seen with significant Doppler flow.

Placental invasion

• Partial invasion into the myometrium (placenta accreta)
• Complete invasion of the myometrium (placenta increta)
• Extension through the myometrium (placenta percreta)

• Loss of the normal myometrial **placental interface** with increased or focal loss of Doppler color flow
• **Vascularized lacunae** within the placenta, and outward bulging of the uterine contour.
• Loss of the bladder wall reflector and the presence of placental tissue or vessels within the urinary bladder

Ultrasound criteria for diagnosis were as follows:

**Greyscale:**
- loss of the retroplacental sonolucent zone
- irregular retroplacental sonolucent zone
- thinning or disruption of the hyperechoic serosa-bladder interface
- presence of focal exophytic masses invading the urinary bladder
- abnormal placental lacunae.

**Colour Doppler:**
- diffuse or focal lacunar flow
- vascular lakes with turbulent flow (peak systolic velocity over 15 cm/s)
- hypervascularity of serosa-bladder interface
- markedly dilated vessels over peripheral subplacental zone.

**Three-dimensional power Doppler:**
- numerous coherent vessels involving the whole uterine serosa-bladder junction (basal view)
- hypervascularity (lateral view)
- inseparable cotyledonal and intervillous circulations, chaotic branching, detour vessels (lateral view).
The main MRI features of placenta accreta include:

- uterine bulging
- heterogeneous signal intensity within the placenta
- dark intraplacental bands on T2-weighted imaging.
• Confirm the ectopic location of the gestational sac
• Evaluate placentation (determine position relative to adjacent structures).

MR findings of early CSEP are similar to ultrasound

• Implantation of the gestation on the cesarean section scar
• Myometrial defect
• Empty endometrial cavity and endocervical canal

Placenta accreta MRI findings

- Dark, irregular **intraplacental bands** on T2-weighted sequences
- Thinning or loss of the subplacental myometrium
- Abnormal vessels
- Outward bulging of the uterine contour
- Invasion of the anterior abdominal wall or urinary bladder
Empty endometrial cavity (EC), myometrial thinning and proximity of the trophoblastic tissue to the urinary bladder B.

Bulging of the LUS contour and a focal absence of the myometrium anteriorly

**Dark T2 placental bands (^), thought to represent areas of placental hemorrhage and infarction.**

First trimester US differential diagnosis

**Spontaneous abortion in progress:**
Gestational sac will be located in the endometrial canal and does not demonstrate the surrounding flow on color Doppler.

First trimester US differential diagnosis

**Cervical ectopic pregnancy:**
- Sac will be located within the endocervical canal rather than within the anterior LUS.
- Myometrium remains intact
- Surrounding color flow

First trimester US differential diagnosis

**Sliding organ sign**
- The sac position and shape will change on short-term follow-up imaging as the abortion progresses.
- Ability to move a failed pregnancy within the endometrial canal with transducer pressure

Both CSEP and cervical ectopic pregnancies frequently contain live embryos with cardiac activity while an abortion in progress will not.

TREATMENT

- Eliminate the embryo
- Decrease the risk of bleeding
- Preserve the uterus to maintain further fertility before the gestational sac rupture and hemorrhage
Observational management

Not recommended

Complications increase as pregnancy progresses.
Catastrophic life-threatening maternal hemorrhage

Growth towards the uterine cavity has been documented sonographically (Cesarean section with hysterectomy)

The natural course of CSEP may be a spontaneous abortion even when carriage to term is desired.

Methotrexate (MTX)

Methotrexate is an antimetabolite that binds to the catalytic site of dihydrofolate reductase, interrupting the synthesis of purine nucleotides and the amino acids serine and methionine, thus inhibiting DNA synthesis and repair and cell replication.

Affects actively proliferating tissues
- Bone marrow
- Buccal and intestinal mucosa
- Respiratory epithelium
- Malignant cells
- Trophoblastic tissue.

Hemodynamically stable patients

Methotrexate Treatment Protocols

Single-dose regimen:*
Single dose MTX 50 mg/m² IM day 1
Measure hCG level on posttreatment days 4 and 7
Check for 15% hCG decrease between days 4 and 7.
Then measure hCG level weekly until reaching the nonpregnant level.
If results are less than the expected 15% decrease, re-administer MTX 50 mg/m² and repeat hCG measurement on days 4 and 7 after second dose. This can be repeated as necessary.
If, during follow-up, hCG levels plateau or increase, consider repeating MTX.

Two-dose regimen:†
Administer 50 mg/m² IM on day 0.
Repeat 50 mg/m² IM on day 4.
Measure hCG levels on days 4 and 7, and expect a 15% decrease between days 4 and 7.
If the decrease is greater than 15%, measure hCG levels weekly until reaching nonpregnant level.
If less than a 15% decrease in hCG levels, readminister MTX 50 mg/m² on days 7 and 11, measuring hCG levels.

(continued)

Methotrexate Treatment Protocols (continued)

Two-dose regimen:‡ (continued)
If hCG levels decrease 15% between days 7 and 11, continue to monitor weekly until nonpregnant hCG levels are reached.
If the decrease is less than 15% between days 7 and 11, consider surgical treatment.

Fixed multidose regimen:‡
Administer MTX 1 mg/kg IM (on days 1, 3, 5, 7), alternate daily with folinic acid 0.1 mg/kg IM (on days 2, 4, 6, 8).
Measure hCG levels on MTX dose days and continue until hCG has decreased by 15% from its previous measurement.
The hCG level may increase initially above pretreatment value, but after 15% decrease, monitor hCG levels weekly until reaching the nonpregnant level.
If the hCG level plateaus or increases, consider repeating MTX using the regimen described.
Mifepristone (RU-486)
Misoprostol (Cytotec)

Can be used in conjunction to stimulate uterine contraction and help expel retained products of conception

Local methotrexate

- Transabdominally or transvaginally
- Amniotic sac is aspirated
- (Potassium chloride)

### Table 1

**Summary of case characteristics and outcomes**

<table>
<thead>
<tr>
<th>Study, year</th>
<th>Number of cases</th>
<th>Patient age (yr)</th>
<th>Gestational age at treatment (yr)</th>
<th>HCG (IU/L)</th>
<th>Local methotrexate dosage</th>
<th>Success rate (1 dose, with additional doses)</th>
<th>Surgical intervention (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ko et al. 2014 [2]</td>
<td>10</td>
<td>34.9 ± 4.8 (26–41)</td>
<td>6.7 ± 1.6 (4.5–9.0)</td>
<td>50666 (1562–159653)</td>
<td>25–58.5 mg</td>
<td>80% (NA)</td>
<td>2</td>
</tr>
<tr>
<td>Yamaguchi et al. 2014 [4]</td>
<td>7</td>
<td>31.7 ± 4.3 (25–38)</td>
<td>7.5 ± 1.2 (6.5–9.4)</td>
<td>31105 (10 957–05 707)</td>
<td>50 mg</td>
<td>71.4% (100%)</td>
<td>0</td>
</tr>
<tr>
<td>Cox et al. 2014 [5]</td>
<td>18</td>
<td>33.7 ± 4.4 (27–40)</td>
<td>6.2 ± 1.1 (5.1–8.3)</td>
<td>12699.5 (2378–149-405)</td>
<td>25–50 mg/m²</td>
<td>61.1% (83.3%)</td>
<td>3</td>
</tr>
<tr>
<td>Yia et al. 2014 [6]</td>
<td>22</td>
<td>28.5 ± 3.5 (NA)</td>
<td>9 ± 5.8 (NA)</td>
<td>40154.2 ± 24±9.2</td>
<td>50–80 mg</td>
<td>95.5% (NA)</td>
<td>1</td>
</tr>
<tr>
<td>Seow et al. 2013 [7]</td>
<td>11</td>
<td>33.2 ± 4.7 (29–42)</td>
<td>6.3 ± 1.2 (52–7.4)</td>
<td>20320 (1290–81 586)</td>
<td>50 mg</td>
<td>45.5% (100%)</td>
<td>0</td>
</tr>
<tr>
<td>Peng et al. 2012 [8]</td>
<td>3</td>
<td>36.7 ± 6.1 (30–42)</td>
<td>7.3 ± 2.2 (6–8)</td>
<td>63352 (22 305–203 311)</td>
<td>50 mg</td>
<td>66.7% (NA)</td>
<td>1</td>
</tr>
<tr>
<td>Frishman et al. 2012 [8]</td>
<td>1</td>
<td>27</td>
<td>6.4</td>
<td>32673</td>
<td>50 mg/mL</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Tagore et al. 2010 [10]</td>
<td>1</td>
<td>38</td>
<td>7</td>
<td>11546</td>
<td>20 mg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Bij de Vaate et al. 2010 [3]</td>
<td>1</td>
<td>38</td>
<td>7</td>
<td>11546</td>
<td>50–75 mg</td>
<td>66.7% (NA)</td>
<td>1</td>
</tr>
<tr>
<td>Pascal et al. 2007 [11]</td>
<td>1</td>
<td>38</td>
<td>7</td>
<td>11546</td>
<td>50–75 mg</td>
<td>66.7% (NA)</td>
<td>1</td>
</tr>
<tr>
<td>Hasegawa et al. 2005 [12]</td>
<td>2*</td>
<td>32</td>
<td>10.5 ± 2.1 (9–12)</td>
<td>NA</td>
<td>50 mg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Hsu et al. 2005 [13]</td>
<td>1</td>
<td>31</td>
<td>6</td>
<td>20377</td>
<td>50 mg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Tan et al. 2005 [14]</td>
<td>2</td>
<td>37.0 ± 2.83 (35–39)</td>
<td>8.3 ± 4 (8.0–8.8)</td>
<td>93615 (587–186 643)</td>
<td>50 mg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Seow et al. 2004 [15]</td>
<td>6</td>
<td>32.2 ± 5.2 (27–41)</td>
<td>6.5 ± 2.5 (6.0–8.4)</td>
<td>21725 (16 628–47 752)</td>
<td>50 mg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Jutkovic et al. 2003 [16]</td>
<td>6</td>
<td>39.4 ± 3.8 (34–43)</td>
<td>6.7 ± 1.5 (3.0–9.0)</td>
<td>20895 (3823–92 880)</td>
<td>1 mg/kg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
<tr>
<td>Groot et al. 1997 [17]</td>
<td>1</td>
<td>33</td>
<td>7</td>
<td>62000</td>
<td>25 mg</td>
<td>66.7% (NA)</td>
<td>2</td>
</tr>
<tr>
<td>Lai et al. 1995 [18]</td>
<td>1</td>
<td>27</td>
<td>7</td>
<td>5789</td>
<td>60 mg</td>
<td>100% (NA)</td>
<td>0</td>
</tr>
</tbody>
</table>

NA = not available/not applicable

* In 1 patient with recurrent CSP

1 n = 3.
Local methotrexate dosage
- 25–58.5 mg
- 50 mg
- 25–50 mg/m²
- 50–80 mg
- 50 mg
- 50 mg
- 50 mg/mL
- 20 mg
- 50–75 mg
- 50 mg
- NA
- 50 mg
- 50 mg
- 50 mg
- 1 mg/kg
- 25 mg
- 60 mg
- 50 mg

Success rate (1 dose, with additional doses)
- 80% (NA)
- 71.4% (100%)
- 61.1% (83.3%)
- 95.5% (NA)
- 45.5% (100%)
- 66.7% (NA)
- 100% (NA)
- 100% (NA)
- 100% (NA)
- 0% (100%)
- 100% (NA)
- 100% (NA)
- 100% (NA)
- 0% (NA)


**Table 2 Clinical outcome of local injection and systemic administration of MTX**

<table>
<thead>
<tr>
<th>Clinical outcome</th>
<th>Local injection</th>
<th>Systemic administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall cure rate (%)</td>
<td>69.2%</td>
<td>67.3%</td>
</tr>
<tr>
<td>Time for serum β-hCG remission (days)</td>
<td>56 (24–92)</td>
<td>42 (21–69)</td>
</tr>
<tr>
<td>Time for uterine mass disappearance (d)</td>
<td>53 (23–88)</td>
<td>40 (20–67)</td>
</tr>
<tr>
<td>Hospitalization time (days)</td>
<td>12.4±6.1</td>
<td>10.9±7.0</td>
</tr>
<tr>
<td>Hospitalization fee (RMB)</td>
<td>4,976.3±4,339.4</td>
<td>4,384.4±4,009.7</td>
</tr>
</tbody>
</table>

*Note:* Data is presented as median with range and mean±SD.

*Abbreviations:* MTX, methotrexate; hCG, human chorionic gonadotropin.
Contraindications to Medical Therapy

Absolute contraindications

Breastfeeding
Overt or laboratory evidence of immunodeficiency
Alcoholism, alcoholic liver disease, or other chronic liver disease
Preexisting blood dyscrasias, such as bone marrow hypoplasia, leukopenia, thrombocytopenia, or significant anemia
Known sensitivity to methotrexate
Active pulmonary disease
Peptic ulcer disease
Hepatic, renal, or hematologic dysfunction

Side effects

Nausea
Diarrhea
Leukopenia
Hepatic dysfunction
Arthralgias
Leg swelling
- Preserving future fertility
- Slow resolution of the CSP
- Variable success of systemic MTX (relative de-vascularized fibrous tissue surrounding the gestational sac and short half-life of MTX, which limits drug exposure when given systemically.)
- Persisting risk of uterine rupture and emorrhage

Suction curettage as first line treatment in cases with cesarean scar pregnancy: feasibility and effectiveness in early pregnancy.

• Contraindicated in an unruptured CSP because it might result in rupture of the implanted gestation and massive hemorrhaging.

• The trophoblastic tissue is outside the uterine cavity and thus unreachable by a curette

• Foley balloon catheter to be inserted for tamponade because of persistent vaginal bleeding (84% success rate)
Curettage or operative hysteroscopy in the treatment of cesarean scar pregnancy.
Qian ZD Arch Gynecol Obstet. 2015 May 3.

- Visualization of implantation site
- Separate gestational sac from myometrium under direct vision
- Loosened embryonic tissue removed by curettage
- Check bleeding and perform electrocoagulation.
- Rapid return to normal b-hCG level (reduction in follow-up time, rapid return to fertility)

Qian ZD Arch Gynecol Obstet. 2015 May 3.
C cesarean scar
diverticulum
E endometrial cavity
G gestational Tissue
I internal os
• Not suitable for an inexperienced surgeon (skillful at manipulating hysteroscopic instruments and familiar to prevent massive bleeding)

• Possible damage to bladder

• Possible uncontrollable bleeding

• Facilities for immediate laparoscopy or laparotomy must be available

Qian ZD Arch Gynecol Obstet. 2015 May 3.
### Table 2  Outcomes of two groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>D&amp;C after UAE</th>
<th>HSC after UAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hospitalization time (days)</td>
<td>7.97 ± 2.49</td>
<td>7.61 ± 3.81</td>
</tr>
<tr>
<td>Hospitalization time after surgery (days)</td>
<td>4.79 ± 2.09</td>
<td>4.85 ± 3.93</td>
</tr>
<tr>
<td>Estimated intraoperative blood loss [mL, median (range)]</td>
<td>20.00 (5.00–100.00)</td>
<td>20.00 (5.00–1500.00)</td>
</tr>
<tr>
<td>Hospitalization cost [CNY, median (range)]</td>
<td>11,186.53 (8585.52–15,721.39)</td>
<td>12,576.01 (10,032.90–25,492.93)</td>
</tr>
<tr>
<td>Decline of serum β-hCG the day after surgery (%)</td>
<td>74.53 ± 12.60</td>
<td>74.27 ± 11.51</td>
</tr>
<tr>
<td>Side effect rate [n (%)]</td>
<td>1 (3.03)</td>
<td>4 (12.12)</td>
</tr>
<tr>
<td>Success rate [n (%)]</td>
<td>33 (100.00)</td>
<td>30 (99.91)</td>
</tr>
<tr>
<td>Hysterectomy rate [n (%)]</td>
<td>0 (0)</td>
<td>1 (3.03)</td>
</tr>
<tr>
<td>Time of bleeding after surgery [days, median (range)]</td>
<td>8.00 (3.00–60.00)</td>
<td>10.00 (2.00–60.00)</td>
</tr>
<tr>
<td>Time of serum β-hCG resolution after surgery (days)</td>
<td>30.15 ± 9.55</td>
<td>34.18 ± 14.12</td>
</tr>
<tr>
<td>Time of CSP mass disappearance [days, median (range)]</td>
<td>60.00 (14.00–92.00)</td>
<td>60.00 (0–91.00)</td>
</tr>
<tr>
<td>Intrauterine pregnancy after CSP [n (%)]</td>
<td>3 (9.09)</td>
<td>3 (9.09)</td>
</tr>
</tbody>
</table>

Preventive Uterine Artery embolization for all patients

Qian ZD Arch Gynecol Obstet. 2015 May 3.
Laparoscopy

- Remove ectopic gestational tissue
- Repair the defect
- Rapid bhcg decrease
- Preserve uterine integrity
- Future fertility
- Exclude bladder involvement

• Hemorrhaging remains a major concern
• Few literature reports
• Risks associated with laparoscopy and further adhesions
• Possible conversion to laparotomy

HIFU (High Intensity Focused Ultrasound)

- Focused ultrasound
- Ultrasound imaging

Acoustic lens concentrate multiple intersecting beams of ultrasound on a target in the body.

Target can be 1x1.5mm or as large as 10x16mm in diameter.
HIFU
(Hight Intensity Focused Ultrasound)
<table>
<thead>
<tr>
<th>Diseases</th>
<th>CARDIOVASCULAR</th>
<th>NEUROLOGICAL</th>
<th>ONCOLOGICAL</th>
<th>WOMEN'S HEALTH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanisms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TISSUE DESTRUCTION</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Thermal Ablation</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Mechanical Destruction</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>DRUG DELIVERY</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Samoporation</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Increased Vascular Permeability</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Local Hyperthermia</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Drug Delivery Venous</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Vascularization</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>OTHER MECHANISMS</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Vasomotorization</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Chemotherapy Sensitization</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Radiation Sensitization</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Neuromodulation</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Immuno modulation</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Cell Cycle</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Nanodynamics Therapy</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Blood Vessel Occlusion/ Coagulation</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Amplification of Cancer Biomarkers</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Stem-Cell Healing</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
Non-thermal cavitation
Mechanical process of vaporization of tissue water which leads to rapidly expanding microbubble production that subsequently collapse and release shock waves and high-speed liquid jets which are associated with extremely high pressures and temperatures.
**Thermal effects**
Absorption of acoustic energy in tissues from viscous shearing and relaxation mechanisms. Target spot reaches temperature greater than 55°C, denaturation and coagulative necrosis of the cells occurs, leading to cell death.
APPROVALS
Europe: CE
China: SFDA
Korea: KFDA
Russian Federation approval
Women’s Health

Uterine Fibroids
Breast Fibroadenomas
Uterine Adenomyosis
Tubal Pregnancy
Fetal Surgery
Ovarian Cancer
Polycystic Ovarian Syndrome

TECHNICAL REPORT

Efficacy of extracorporeal ultrasound-guided high intensity focused ultrasound: An evaluation based on controlled trials in China

Jun Luo¹, Xueyi Ren² & Tinghe Yu³

¹Hospital of Stomatology, Chongqing Medical University, Chongqing, ²Chongqing Institute for Food and Drug Control, Chongqing, and ³Key Medical Laboratory of Obstetric and Gynecology, The Second Affiliated Hospital, Chongqing Medical University, Chongqing, China

Magnetic Resonance-Guided Focused Ultrasound Myomectomy: Safety, Efficacy, Subsequent Fertility and Quality-of-Life Improvements, A Systematic Review

Salvatore Gizzo, MD¹, Emanuele Ancona, MD¹, Omar Anis, MD¹, Carlo Saccardi, MD, PhD², Tito Silvio Patrelli, MD², Donato D’Antona, MD¹ and Giovanni Battista Nardelli, MD¹
High-intensity focused ultrasound combined with suction curettage for the treatment of cesarean scar pregnancy.

Inclusion

Gestational age <8 weeks

Exclusion

• Pelvic inflammatory diseases
• Previous treatment for CSP
Suction curettage under hysteroscopic guidance 2.9 days after HIFU ablation.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number or Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median total treatment time, min</td>
<td>73 (range, 13–160)</td>
</tr>
<tr>
<td>Median sonication time, s</td>
<td>600 (range, 100–1538)</td>
</tr>
<tr>
<td>Sessions of HIFU ablation</td>
<td>1</td>
</tr>
<tr>
<td>Depth of the uterus, cm</td>
<td>10.0 ± 1.5 (range, 8–14)</td>
</tr>
<tr>
<td>Median blood loss, mL</td>
<td>20 (range, 10–400)</td>
</tr>
</tbody>
</table>

**Follow up**

- Ultrasound result 1 month later: 49
- No pregnancy tissue retained: 4
- Pregnancy tissue retained*: 15 (range, 2–40)
- Median duration of vaginal bleeding after HIFU, days: 33.2 ± 8.1 (17–60)
- Normal menstrual recovery, days: 27.6 ± 6.4 (10–40)
- Time of hospital stay, days: 7.8 ± 1.5 (5–11)

*Pregnancy tissue retained* indicates retained pregnancy tissue after HIFU ablation.

These adverse effects can be explained by uterus contraction after HIFU.

OBJECTIVE: The aim of this preliminary study was to investigate whether ultrasound-guided high-intensity focused ultrasound (HIFU) can play a role in treating cesarean scar pregnancy (CSP).

STUDY DESIGN: Between November 2011 and December 2012, 16 patients with CSP were treated with ultrasound-guided HIFU ablation. Successful treatment was defined as disappearance of CSP mass, undetectable serum beta human chorionic gonadotropin, and no serious complications such as severe bleeding, uterine rupture, or hysterectomy.

RESULTS: All patients were successfully treated in the outpatient department and none required readmission. After 2-5 treatment sessions, the mean time for achieving undetectable serum beta human chorionic gonadotropin was $4.94 \pm 2.32$ weeks, and the mean time for CSP mass disappearance was $6.69 \pm 3.36$ weeks. Three patients experienced moderate abdominal pain that subsided in 1-2 days, and nine patients experienced mild vaginal bleeding (<30 mL) that resolved within 2-3 days. All 16 patients had recovered their normal menstruation function at follow-up.

CONCLUSION: These preliminary results suggest that ultrasound-guided HIFU ablation is a noninvasive, feasible, and effective method for the treatment of CSP.
• HIFU ablation could be used to kill CSP tissues and destroy small blood vessels around the CSP.

• HIFU may help reduce the blood loss during the procedure of suction curettage under hysteroscopic guidance.

• Removing cardiac activity there is no longer growth of the CSP

• Thermal effect of HIFU can destroy the pregnancy tissue by damaging the microvascular system within the tissue
WHAT'S NEXT?