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Author(s): Tsung-Hsin Yeh, Chia-Yun Lin, Fu-Tsai Kung

Affiliation of author(s): Department of Obstetrics and Gynecology, Kaohsiung Chang Gung Memorial Hospital, Kaohsiung, Taiwan and Department of Obstetrics and Gynecology, Chiayi Chang Gung Memorial Hospital, Chiayi, Taiwan

Corresponding author name: Tsung-Hsin Yeh and Fu-Tsai Kung

Title: Assessment of Minimally Invasive Strategies in Managing High-Risk Low-Lying Implantation Ectopic Pregnancy

Aims and objectives: To identify predictors of complicated low-lying implantation ectopic pregnancy (LLIEP)—including cesarean scar pregnancy, cervical pregnancy, and low segment implantation—and assess their significance in guiding minimally invasive hemostatic management.

Settings and Design: This retrospective study included 153 LLIEP patients who underwent suction D&C, with or without additional invasive procedures, from October 1999 to March 2025.

Materials, setting and methods: Patients were categorized as complicated or uncomplicated. Complicated LLIEP was defined by the need for uterine artery ligation, embolization, intraoperative blood loss >500 mL, or the use of either intracervical balloon compression or transcervical Bosmin injection. Clinical and sonographic characteristics were compared between groups. Statistical analysis included logistic regression and ROC analysis to identify predictors of complication.

Results: Among 153 patients, 122 (79.7%) had cesarean scar pregnancies, 29 (19.0%) cervical pregnancies, and 2 (1.3%) low segment implantations. Sixty-six cases (43.1%) were classified as complicated; 87 (56.9%) were uncomplicated. The complicated group had higher rates of deep implantation (80.3% vs. 28.7%), fetal heart activity (50.0% vs. 23.0%), larger gestational mass diameter (57.0 vs. 36.9 mm), and elevated serum beta-hCG (69,382.9 vs. 31,948.3 mIU/mL). Operative time was longer (224.4 vs. 40.8 minutes), as were intraoperative blood loss (325.8 vs. 45.0 mL) and postoperative hospital stays (3.7 vs. 0.5 days). Univariate analysis identified gestational age >6.5 weeks, fetal heart activity, maximal diameter of gestational mass (MDM) >48.2 mm, deep implantation, and beta-hCG >43,870 mIU/mL as significant predictors. Multivariate analysis revealed deep implantation (OR 31.929, $p < 0.001$) and MDM >48.2 mm (OR 6.279, $p = 0.001$) as independent risk factors.

Conclusion: Both deep implantation and MDM >48.2 mm independently predict complicated LLIEP and warrant perioperative planning for aggressive hemostatic interventions.

Keywords: LLIEP, cesarean scar pregnancy, laparoscopic uterine artery ligation, prediction model