

# Ultrasound evaluation of post-cesarean uterine wound healing based on a figure of eight suturing technique



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## ABSTRACT

**Introduction:** A niche (also called an isthmocele) is a defect or uterine scar that can be detected by ultrasound a few weeks or months after delivery by cesarean section. A niche is often associated with obstetric complications in subsequent pregnancies, including uterine dehiscence and/or rupture, placenta previa, and placenta accreta. Placenta accreta is characterized by abnormal attachment of the placenta to the uterine wall and is one of the leading causes of maternal morbidity and mortality in developing countries. Therefore, this study aims to evaluate the healing of surgical wounds with the figure of eight suturing techniques.

**Methods:** This study included 32 primigravida patients who underwent cesarean section at RSIA (Mother & Child Hospital) Rosiva from March 2006 to July 2006. On day 6 of the puerperium, the uterine sutures were examined with transvaginal ultrasound. Patients were subsequently allowed to return to their homes to receive outpatient treatment. On day 40, the patients were requested to return to the hospital for a follow-up ultrasound examination.

**Results:** On day 6, incomplete wound healing was found in 31 patients (96.9%) and complete wound healing in 1 patient (3.1%). On day 40, 31 patients (96.9%) experienced perfect or complete healing. Statistical analysis showed a significant difference in wound healing between day 6 and day 40 ( $p = 0.0001$ ).

**Conclusion:** On day 40 after cesarean section, as many as 96.9% of patients showed perfect/complete wound healing (type I) without a niche. Therefore, these patients had a low risk of obstetric complications associated with uterine scarring in subsequent pregnancies.

**Keywords:** Cesarean section, Niche, Isthmocele, Placenta accreta, Single-layer uterine closure.

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## INTRODUCTION

The incidence of cesarean section (CS) continues to increase every year. Data in the United States show that approximately 30% of women give birth by cesarean section, with more than 70% having scar defects or a uterine scar, also known as a niche/isthmocele. Niches can be detected by ultrasonography several weeks or months after delivery and are often associated with obstetric complications in subsequent pregnancies such as uterine dehiscence and/or rupture, placenta previa, and placenta accreta.<sup>1</sup>

Placenta accreta spectrum (PAS), which is characterized by abnormal attachment of the placenta to the uterine wall, is one of the leading causes of maternal morbidity and mortality in developing countries. In placenta accreta, trophoblast invasion will pass through the decidua basalis

layer and into deeper layers such as the myometrium (placenta accreta/increta) and a serous layer of the uterus, as well as into the surrounding organs (vesica urinaria, intestines, ligaments, and pelvic structures). The incidence of placenta accreta has been reported to vary between 1/500 – 1/700, with a case-fatality rate of 1/143.<sup>1-3</sup>

Surgical techniques used in closing the uterus post-CS have been found to affect the healing of uterine scars, as well as niche and uterine wall thickness (i.e., RMT – residual myometrium thickness).<sup>1-4</sup> There are several techniques for suturing the lower uterine segment, with the “figure of eight” suture considered to provide a better result, especially for controlling bleeding. In addition, this type of suture has several advantages. First, it can be easily removed. Second, it allows the closure of two uterine layers at the same time. Third, because of

the suture’s geometric structure, it does not cause excessive ischemia at the suture edges. Another suture technique involves closing two layers as one layer. In a single-layer closure, the myometrium and perimetrium layers are sutured together. This single-layer suturing technique can result in a niche, however, which is one of the risk factors for placenta accreta. Therefore, this study aims to evaluate the healing of surgical wounds with the figure of eight suturing techniques.

## MATERIALS AND METHODS

This study followed a prospective research design and used an analytical approach. This study took place in RSIA (Mother & Child Hospital) Rosiva from March 2006 to July 2006. Determination of the number of participants was obtained using a conservative sampling technique by taking

the entire population that met the inclusion and exclusion criteria for the study. The inclusion criteria for the participants in this study were single pregnant patients, 30 years of age or younger, first post-cesarean section, no congenital abnormalities, and willingness to participate in the study. Exclusion criteria were the following: patients with diabetes mellitus, heart disease, malnutrition, chronic anemia, puerperal infection, or uterine myoma identified before surgery, and cesarean section followed by subtotal hysterectomy (STAH).

Data collected from the study are primary data. On day 6 of the puerperium, the uterus was examined by PANAVIDA transvaginal ultrasound. Following the ultrasound, the study participants were allowed to go home for outpatient treatment. On day 40, the study participants were requested to return to the hospital for a follow-up ultrasound examination. The estimated healing process of the uterine wound after CS (hypothesis) is classified into Types 1 to 6. Type 1 is complete wound healing, in which all layers are properly fused. In Type 2 healing, the wound does not fuse the serous layer to a portion of the myometrial layer. Type 3 wound healing does not fuse the endometrial layer to a portion of the myometrial layer. In Type 4 the wound fuses well to only a portion of the myometrial layer. In Type 5, only the serous layer and the endometrial layer are fused, whereas the myometrial layer is not fused. In Type 6 wound healing is incomplete (i.e., not fused) overall.<sup>5</sup> The results from the ultrasound were tabulated to the master table for statistical analysis using SPSS version 12.0 with Fisher Exact, Wilcoxon, and McNemar tests.

**RESULTS**

The study included 32 patients, where all of the samples were 20 – 30 years of age. A total of 16 participants (50%) were parity 1, fifteen (46.9%) were parity 2, and one participant (3.1%) was parity 3. As shown in Table 1, 15 (46.9%) patients had a normal body mass index, 12 (37.5%) had an overweight body mass index, and 5 (15.6%) had an obese body mass index. The three most common indications for cesarean section in this study were breech position, high neonatal weight, and failure

**Table 1. Distribution of Study Participant Characteristics.**

Characteristics	Frequency (N)	Percentage (%)
<b>Age</b>		
30 – 30 years old	32	100
<b>Parity</b>		
1	16	50
2	15	46.9
3	1	3.1
<b>Body Mass Index</b>		
Normal	15	46.9
Overweight	12	37.5
Obesity	5	15.6
<b>Abortion History</b>		
No	29	90.6
Yes	3	9.4
<b>Curettage History</b>		
No	29	90.6
Yes	3	9.4
<b>C-Section Indication</b>		
High neonatal weight	5	15.6
Precious infant	2	6.3
Fetal distress	3	9.4
High risk	1	3.1
Condyloma	1	3.1
Transverse	3	9.4
Breech	5	15.6
Placenta previa	3	9.4
Narrow hips	3	9.4
Failure to progress	5	15.6
Placental abruption	1	3.1

**Table 2. Distribution of Ultrasound Results on Day 6 and Day 40.**

	Day 6		Day 40		P-value
	n	%	n	%	
<b>Scar Type</b>					
1	1	3.1	3	96.9	0.0001*
2	5	15.6	1	0	
3	15	46.9	0	3.1	
4	3	9.4	1	0	
5	2	6.3	0	0	
6	6	18.7	0	0	
<b>Healing</b>					
Complete	1	3.1	31	96.9	0.0001**
Incomplete	31	96.9	1	3.1	

\*Wilcoxon test

\*\*McNemar test

**Table 3. Association between Day 40 Wound Healing and Body Mass Index.**

	Complete		Incomplete		P-value
	n	%	n	%	
<b>Body Mass Index</b>					
Normal	14	43.7	1	3.1	0.557
Overweight	12	37.6	0	0	***
Obesity	5	15.6	0	0	

\*\*\*\*Fisher-Exact Test

to progress (FTP), they were 5 patients each (15.6%).

As shown in table 2, the most common type of scar found on day 6 was type 3

(15 patients; 46.9%). Type 3 is a form of wound healing that does not coalesce from the mucosal layer to the myometrial layer. The least frequent scar type observed on day 6 of wound healing was type 1, in which the wound healed completely without any defects. Whereas type 1 was the most common type of scar observed on day 40. A significant difference between the types of scars on day 6 and day 40 was observed ( $p = 0.0001$ ).

By the normal physiological process of wound healing, on day 6 the uterine incision was in the fibroplasia phase, where wound healing was not yet complete. On day 40, the wound healing process was in the scar maturation phase, with complete wound healing observed in 31 (96.9%) patients.

As shown in [Table 2](#), on day 6 a total of 31 (96.9%) patients had incomplete wound healing, while 1 patient (3.1%) showed complete wound healing. On day 40, 31 patients (96.9%) had experienced complete healing. On day 40, 1 patient (3.1%) had incomplete wound healing. One patient undergoing incomplete healing on day 40 had parity 2, no history of abortion and curettage, normal body mass index, and a cesarean section that was performed due to a failure to progress (FTP). The risk of incomplete wound healing in this patient resulted from prolonged compression of the lower uterine segment (LUS) by the baby's head, resulting in tissue ischemia in the lower uterine segment, a condition that affects subsequent wound healing. While 31 patients (96.9%) experienced perfect or complete wound healing. Statistical analysis with the Wilcoxon test and McNemar test showed a significant difference in wound healing between day 6 and day 40 ( $p = 0.0001$ ).

As shown in [Table 3](#), 14 patients (43.7%) had a normal body mass index and experienced complete healing. Twelve patients (37.6%) had an elevated (overweight) body mass index and had complete wound healing. Five patients (15.6%) with a highly elevated (obese) body mass index experienced complete or complete healing. Only patients (3.1%) with a normal body mass index experienced incomplete wound healing. Fisher-Exact Test No statistically significant association between body mass index and wound healing.

## DISCUSSION

This study found the majority of the sample was 20 – 30 years of age, with 50% of the participant being first parity. The three most common indications for cesarean section in this study were breech position, high neonatal weight, and failure to progress (FTP), they were 5 patients each (15.6%). For comparison, data recorded from 1999 – 2003 at RSUP (Central General Hospital) H. Adam Malik and RSU (General Hospital) Dr. Pirngadi Medan on the number of cesarean sections were as follows: A total of 2,901 patients presented with the three most common indications for cesarean section: 419 patients with abnormal fetal position (14.4%); 407 patients of cephalopelvic disproportion (CPD) (14%); and 370 patients with failure to progress (FTP) (12.7%).<sup>6</sup>

Cesarean section is a procedure to deliver the fetus, placenta, and membranes through an incision in the abdominal wall and the uterus. Based on early developments in surgical technique, in 1926 Kerr recommended a two-layer closure of the lower uterine segment transverse incision. In Williams Obstetrics (15th edition) Pritchard and MacDonald first suggested that uterine incisions could be closed either in one layer or, more traditionally, in two layers with continuous chromic sutures.<sup>7,8</sup> Double-layer uterine closure was the standard method, in which the uterine incision was closed in two layers. Each layer can be continuous, continuously locked, or disconnected. The first layer is outside the endometrial layer (myometrium), whereas the second layer includes the serous layer (perimetrium) to ensure hemostasis and complete closure. Single-layer uterine closure is a technique that involves both the myometrium and perimetrium layers, which are sutured together in a single layer. This suturing technique can be continuous, continuously locked, or disconnected.<sup>9-12</sup>

Major surgical procedures such as cesarean section or myomectomy that cut into the entire uterine wall will result in scars in all layers of the myometrial smooth muscle. Unlike the epithelial lining of the endometrium and peritoneum, which heals by regeneration and recolonization of the scarred area, the myometrium does

not heal by regenerating muscle fibers. Instead, it forms “foreign” substances including collagen so that the resulting scar tissue is less elastic and more prone to injury/rupture in subsequent pregnancies. Women who've undergone repeated CS are twice as likely to develop a placenta accreta spectrum (PAS) disorder.<sup>2,3</sup>

The strong epidemiological association between placenta previa and PAS findings suggests that decidual defects following scar formation in the uterine myometrium hurt early implantation by promoting attachment of the blastocyst to the scar tissue and facilitating deep abnormal invasion. In the secretory phase, the circulation of leukocytes to the endometrium increases. In addition, both uterine artery resistance and uterine blood flow volume as a fraction of maternal cardiac output increase. Overall, these data indicate a possible association between poorly vascularized uterine scar areas and increased resistance to blood flow in uterine circulation. Large areas of scar tissue tend to hurt the re-epithelialization of the endometrium.<sup>2,3</sup>

The estimated healing process of the uterine wound after CS (hypothesis) is classified into Types 1 to 6. Type 1 is complete wound healing, in which all layers are properly fused. In Type 2 healing, the wound does not fuse the serous layer to a portion of the myometrial layer. Type 3 wound healing does not fuse the endometrial layer to a portion of the myometrial layer. In Type 4 the wound fuses well to only a portion of the myometrial layer. In Type 5, only the serous layer and the endometrial layer are fused, whereas the myometrial layer is not fused. In Type 6 wound healing is incomplete (i.e., not fused) overall.<sup>5</sup>

Uterine niche (also known as isthmocele) is an iatrogenic niche-like defect at the site of a CS wound due to incomplete tissue healing. Radiologically, a niche is defined as a triangular, hypoechoic, or anechoic area of the wound. Niches are also described as indentations with a depth of at least 2 mm in the myometrium. A niche occurs in almost 70% of patients who have previously undergone cesarean section. Risk factors for the occurrence of a niche can be associated with the patient and the surgical process.<sup>13-16</sup>

Concerning the patient's experience while undergoing cervical dilatation >5 cm which occurred throughout >5 hours, a reduction in vascularity in the myometrium occurred, resulting in inadequate healing. Disorders that impair healing function such as low hemostatic function, inflammation, and gestational diabetes (OR 1.73), history of previous cesarean section (OR 3.14), and high body mass index (OR 1.06) were independent risk factors. However, in the current study, no association between BMI and the incidence of scarring/niche was observed.<sup>13-16</sup>

In terms of the cesarean section procedure, a uterine incision in the lower segment towards the cervix typically results in poor healing because the mucus secreted by the cervical glands can increase the size of the niche. Nearly 95% of patients with a niche received sutures from a single-layer suture technique and without any peritoneal closure. The double-layer technique with non-locking sutures is currently considered the most optimum procedure, as it promotes a thicker residual myometrial wall and reduces the risk of niches. Suboptimal surgical techniques such as inadequate hemostasis, tissue ischemia, devascularization, and excessive tissue manipulation can cause poor wound healing and adhesion leading to niches.<sup>13-18</sup>

An alternative to the technique that utilizes interrupted sutures (i.e., Donati-Blair suture) and one that is commonly used for skin closure, is the "figure of eight" suture, which is considered to provide better results, in particular concerning controlling hemorrhage. This type of suture has several advantages. First, it can be easily removed. Second, it allows the closure of two layers at the same time. Third, because of its geometric structure, it does not cause excessive ischemia of the suture edges compared to that of the Donati-Blair suture. In addition, this technique allows an even distribution of different flap lengths to be sutured. If performed correctly, it will produce a thin, and even linear, wound.<sup>15,19,20</sup>

The primary prevention of niche development is to minimize the number of cesarean sections. A secondary preventive measure involves using a surgical technique that ensures a thicker residual myometrial

wall and a strong scar. Research involving 138 women indicated that uterine closure using the "far-far-near-near double layer unlocked" technique may be beneficial in reducing niche formation and ensuring adequate myometrial residual walls.<sup>13,14,16</sup> This study also has some limitation, which is observations were only made on the 40<sup>th</sup> day and should be followed in the following 6 month

## CONCLUSION

On day 40 following the cesarean section, as many as 96.9% of patients showed complete wound healing (type 1) without a niche, so it can be concluded that this population of patients has a low risk of obstetric complications associated with uterine scarring in subsequent pregnancies. Transvaginal ultrasound can be carried out on day 6 and day 40 to evaluate the wound healing process following cesarean section as a baseline for assessing the potential for placenta accreta.

## ETHICAL APPROVAL

This study has been approved by the Ethics Commission of the Faculty of Medicine, University of North Sumatra. All study participants have provided written consent as evidence of their willingness to participate in the study.

## CONFLICT OF INTEREST

None of the authors reports a conflict of interest.

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