Review Article

Cesarean Scar Defect and Its Complications

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Cesarean section (CS) rate has been increasing significantly in the past few decades. It has created new challenges to the healthcare provider. The CS scar-related diseases are reported in obstetrics and gynecology. The integrity of CS scar depends on several factors such as number of CS, uterine position, peripartum infection, myometrial healing, repairing technique, and scar formation process. Cesarean scar defect (CSD) occurs by influence of these factors, and it brings about a large spectrum of health conditions. CSD complications have been producing distressing events to countless patients physically and psychologically. Prompt recognition of the CSD and appreciation of its possible complications would help raise awareness, provide timely intervention and is lifesaving.

Keywords: Cesarean scar defect; Uterine niche; Complication

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In recent decades, cesarean section (CS) rate has been increasing worldwide both in developed and developing countries. In Asia the rate increases from 4.4% in 1990 to 19.5% in 2014[1]. This major surgery is becoming popular for multifactorial reasons, including changes in maternal preferences, obstetrician practice style, overdiagnosis of cephalopelvic disproportion and desire to conserve pelvic floor[2,3]. With the medical indication, CS is a procedure of paramount importance. It could reduce maternal/fetal morbidity and mortality. However, CS is associated with several early and long-term consequences. Due to substantial increase in CS rates, the healthcare system is facing new challenges of CS-related complications, especially in the population with repeated procedure[4].

Cesarean scar defect (CSD) is one of many known complications of CS delivery. CSD can be regarded as isthmocele, cesarean scar recess, uterine niche or uterine diverticulum. It is defined as a discontinuity of uterine endometrium and portion of or whole layer of the myometrium as a result of the healing process of CS wounds[5]. Some studies define it as a reservoir-like pouch defect at anterior wall of the uterine isthmus, located at the site of previous cesarean scar[6]. In 1995, Morris first highlighted the anatomical abnormalities developed in uterus with previous CS. Hysterectomy specimens were examined and found significant pathological alterations. Pathological features mentioned were distorted and widened lower uterine segment, congested endometrium, focal adenomyosis, polyps formation in the scar recess, lymphocytic infiltrations, and residual suture materials with foreign body giant cell reaction[7]. Alshiemy et al in 2014 also discovered corresponding histopathological findings in hysterectomy specimens with history of CS. They reported congested endometrial fold, isthmus distortion, lymphocytic infiltration, polyps at scar site, localized adenomyosis, and myofiber disarray. Some of the findings such as uterine distortion and disorganized muscle fibers correlate with number of previous CS[8].

The single etiology of CSD is previous cesarean delivery. Avoidance of unnecessary CS leads to more favorable obstetrical and gynecological outcomes. Many risk factors that contribute to CSD development are largely under discussion and require further research. Recognized risks include but are not limited to multiple CS, retroflexed uterus, multifilament suture materials, suturing techniques, levels of presenting part, duration of labor, cervical dilatation, and pre-eclampsia[9-12].

How to diagnose CSD

CSD could be detected by transvaginal ultrasound examination. In terms of diagnosis, most experts agreed that the indentations should have a depth of at least 2 mm on transvaginal ultrasound (Figure 1), and classify them as 1) simple niche; 2) simple niche with single branch; 3) complex niche (more than 1 branch) as shown in Figure 2. A branch should also be a thinner portion of the main niche and directed towards uterine serosa[13]. There is no current universally accepted standard on diagnosis of CSD. The Delphi and modified Delphi method are reported by experts and are the best available methods we have today in measurement standardization[14]. In short, CSD measurement is done on the midsagittal plane of the uterus, identifying the remaining myometrial thickness (RMT), length and depth of niches at

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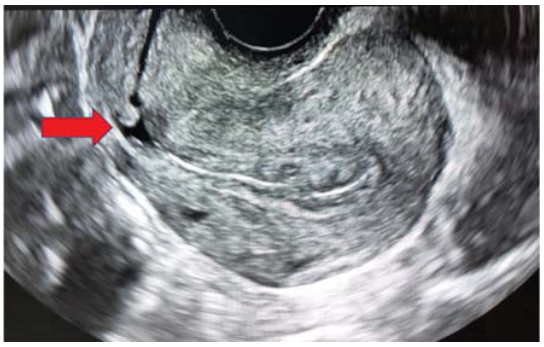

Figure 1. Tranvaginal sonography demonstrates cesarean scar defect (arrow) in retroflex uterus.

the area of uterine incision. Also, gel or saline contrast sonohysterography has added value to the imaging technique, allowing clearer visualization[11]. In unenhanced transvaginal ultrasonography, the best timing for CSD investigation is at mid-cycle period as the cervical mucus act as an excellent contrast media[8]. The magnetic resonance imaging (MRI) has been shown as a promising tool in evaluating CSD as well. Using T2-weight scan, it can evidently indicate CSD and its characteristics[15]. Due to its expensive cost and is less widely available than transvaginal ultrasound, it is unclear whether MRI has more practical advantage than transvaginal ultrasound.

CSD complications

It is imperative that we must recognize CSD due to its potential of having short- and long-term complications. There are reports CSD may affect immediate surgical outcome, increasing incidence of fever, endometritis, wound infection and urinary tract infection[16]. However, the long-term complications are more worrisome. In the long run, the range of impact is vast; with the spectrum from mild symptoms to highly deleterious consequences (Table 1).

Non-pregnancy related conditions

Many gynecologic symptoms as a result from CSD are mild and not life threatening. However, they do affect the quality of life (QoL) considerably. One study demonstrastes that presence of mild gynecologic symptoms or subfertility results in lowered self-esteem, negative emotions and interpersonal relationship[17].

Abnormal vaginal bleeding (AUB) is a common complaint at the gynecologic outpatients. Menorrhagia, postmenstrual bleeding, or other abnormal bleeding is a result from congested endometrial fold, small polyps in the scar recess and accumulation of blood in the niche pouch[5,11,18]. The poorly contracted muscle in the scar from myofiber disarray is hypothesized to cause of the accumulation and delayed bleeding. Various reports reveal the degree of AUB correlates with the size of the CSD. The larger niches accumulate more fluid and have a tendency to cause abnormal bleeding[18-20]. Typical postmenstrual spotting is defined as a

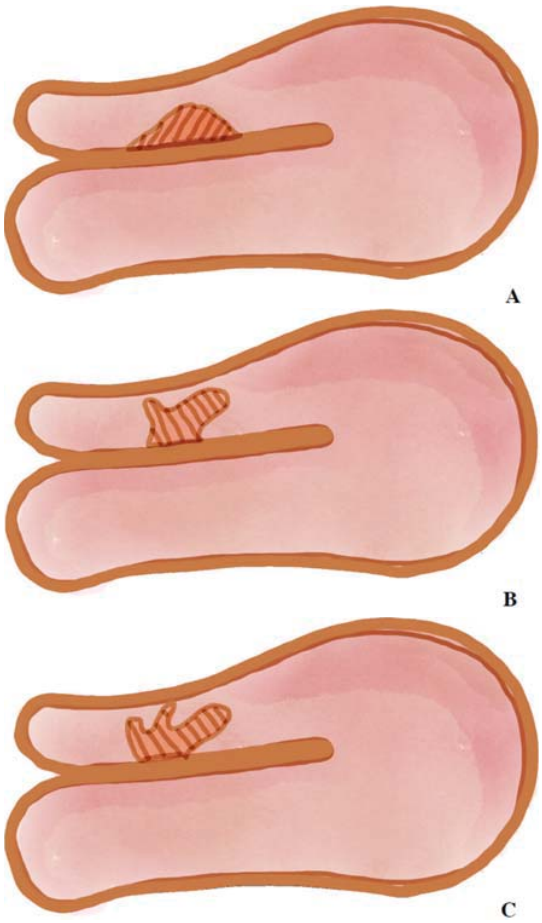

Figure 2. Type of cesarean scar defect: A) simple niche, B) simple niche with single branch, C) complex niche.

Table 1. List of cesarean scar defect complications

Non pregnancy related	Pregnancy related
Abnormal vaginal bleeding	Miscarriage
Chronic pelvic pain	Preterm birth
Postmenstrual spotting	Cesarean scar pregnancy
Uterine distortion	Placenta previa
Focal adenomyosis	Placenta adherens spectrum
Infertility	Uterine rupture
Impaired quality of life	

persistent light bleeding from 2 to 12 days after menstruation ceased, and is widely documented to be associated with CSD[20]. The challenge is this type of spotting without other uterine pathology is difficult to treat conservatively. Studies have shown hormonal therapy failed to alleviate the condition. In some situations, invasive management such as hysterectomy is offered to patients. One case report reveals massive recurrent uterine bleeding with hemorrhagic shock from a cesarean scar with successful laparoscopic cesarean scar repair[21]. The symptoms of AUB, therefore, range from minor complaint to a more serious situation that requires immediate surgical management.

Lymphocytic infiltration together with lower uterine segment distortion as a result from CS is believed to cause of chronic pelvic pain and dyspareunia[5]. Chronic pelvic pain and dyspareunia are conditions which may lead to significant distress and produce emotional sequelae. Not only do they affect a woman's physical health, emotional health, and body image but also relationships with her partner[22,23]. These symptoms should be regarded in healthcare practice. Other than chronic pelvic pain and dyspareunia, there is an association found between uterine niche and dense fibrotic pelvic adhesions. The adhesions could potentially extend from the CSD to the bladder and abdominal wall. They contribute to further niche development and causing retroversion positioning of the uterus[24]. A retroverted uterus, consequently, is associated with further pelvic pain, dyspareunia, urinary incontinence and fertility problems. It is also one of the risk factors for CSD development, which may affect subsequent pregnancy even further[25]. Also, retroversion is the most common uterine configuration in the event of incarcerated uterus[26].

Adenomyosis is the presence of endometrial stroma and glands in the myometrium and could lead to pelvic pain, dysmenorrhea and abnormal bleeding[27]. In histopathological finding, CSD is associated focal iatrogenic adenomyosis at the scar site. It is believed to create pelvic pain and dysmenorrhea in post-CS patients[11,28].

The CSD related gynecological condition mentioned above are pelvic pain, uterine retroversion, pelvic adhesion and adenomyosis. They could potentially create a hideous loop of adverse symptoms. One condition may lead and contribute to another, and unfortunately may circulate back to the starting symptom, only in worsening manner.

Infertility following cesarean section is problematic. There are several hypotheses and mechanisms regarding CSD and secondary infertility. Accumulation of fluid at the uterine niche may impair embryo implantation. This effect is supported by subfertility in patients with intrauterine fluid[29]. Not only the accumulated fluid may be embryotoxic, but also the presence of flowing fluid that cause mechanical impediment towards embryo implantation. Sperm penetration is also affected. There may be no fertilization at all. The sperm may not be able to penetrate through the accumulated blood and mucous content at the CSD[30-32]. As mentioned above in the histopathological finding, inflammation and lymphocytic infiltration is abundant in the region of scar recess[7,8]. Altered immunobiology has a negative impact on pregnancy outcome. The inflamed area provides an unsuitable environment for embryo implantation. Ben-Nagi et al discovered fewer vascularization at the CSD scar site when compared to normal endometrium[33]. Therefore, altered environment by the impact of CSD may associate with failure to conceive.

Poor muscle contractility also contribute to implantation failure. Endometrium has a wavelike contraction pattern, and adequate wave pattern is partly responsible for successful conception[34]. It is postulated the wave pattern is disrupted in the presence of uterine niche due to poor muscle array and density. Moreover, by the influence of CSD, the uterine anatomy alterations such as distortion and retroflexion are assumed to limit successful embryo transfer and impair conception[31].

Psychological factor also contributes to infertility. Pelvic pain, pelvic adhesion and dyspareunia interfere with satisfactory coital response and could result in decreased sexual engagement. AUB, such as postmenstrual spotting, prolonged menstruation and intermenstrual bleeding, could happen in unpredictable manner. Couples tend to avoid coitus during vaginal bleeding and spotting[31,35]. These factors may create self-insecurity, shame, sense of failure and eventually lead to sexual dysfunction[31].

Pregnancy related conditions

Cesarean scars and CSD could remarkably affect subsequent pregnancies. The important measures include avoidance of unnecessary CS and ability to recognize the subclinical cues of the complications. The complications arise during pregnancy are rare but are destructive and associated with high morbidity and mortality. These include but not limited to preterm delivery, cesarean scar pregnancy, placenta adherens spectrum and uterine rupture.

The burden of preterm delivery is extensive. Preterm births are associated with perinatal and pediatrics morbidity and mortality[36]. There are several well-known risks of preterm birth and studies have now deduced that uterine scar and niche are causative factors[37-39]. The pathophysiology still requires further investigation but is hypothesized to be from altered microenvironment, abnormal placentation, increased inflammation, dehiscence of uterine tissue, changed cervical function due to prior iatrogenic damage, and accumulation of fluid or blood product at the niche[37].

Cesarean scar pregnancy incidence has been rising due to increased CS rates. In a systematic review by Rotas et al, more than half (52%) of reported cesarean scar pregnancies had only one previous CS[40]. It is a form of ectopic pregnancy[41]. The implantation is at the previous surgical site, as the gestational sac and sometimes bulk of placenta are situated in the niche as shown in Figure 3. Most common presentation is painless vaginal bleeding. A false-negative diagnosis or an expectant management may lead to considerable consequences such as hysterectomy, uterine rupture, and hemorrhagic shock[40,42]. A hysterectomy specimen with cesarean scar pregnancy is shown in Figure 4.

Placement of vacuum curettage in the event of misdiagnosis as pregnancy abortion could potentially lead to life-threatening hemorrhage[32,42]. A strong awareness of cesarean scar pregnancy is required to avoid misdiagnosis and adverse obstetrical outcomes.

Together with cesarean scar pregnancy, the rate of placenta previa and/or placenta adherent (placenta accreta, increta and percreta) also increases. Placenta adherens spectrum is a well-known obstetrical challenge and is associated with previous uterine scar. Previous CS is the highest contributory risk factors of abnormal placentation[43]. This happens when the placenta implants in the existed uterine scar and niche or at a localized uterine injury. Pathophysiology is not entirely proven but is postulated based on clinical presentation, associated risk factors and histopathology findings. The adherent placenta is believed to develop from a combination of absence of decidua, abnormal uterine vascular remodeling, presence of inflammation and several imbalance signaling pathways[44]. These abnormalities and imbalances are found in uterus with previous cesarean scar. Failure to recognize the pathologically adherent placenta may lead to devastating and life-threatening outcomes such as uterine rupture, profuse bleeding, hemoperitoneum and shock at any pregnancy trimester[45]. In first or second trimester, the severely adherent placenta may lead to uncontrolled postabortion hemorrhage, during dilatational and curettage procedure or even after. In some instances, emergent total abdominal hysterectomy would be required for hemorrhage control[43,46,47].

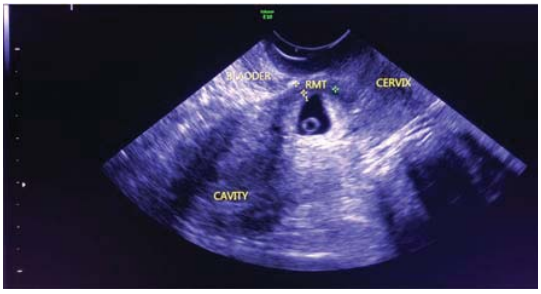

Figure 3. Transvaginal ultrasonography showing gestational sac located inside the uterine scar.

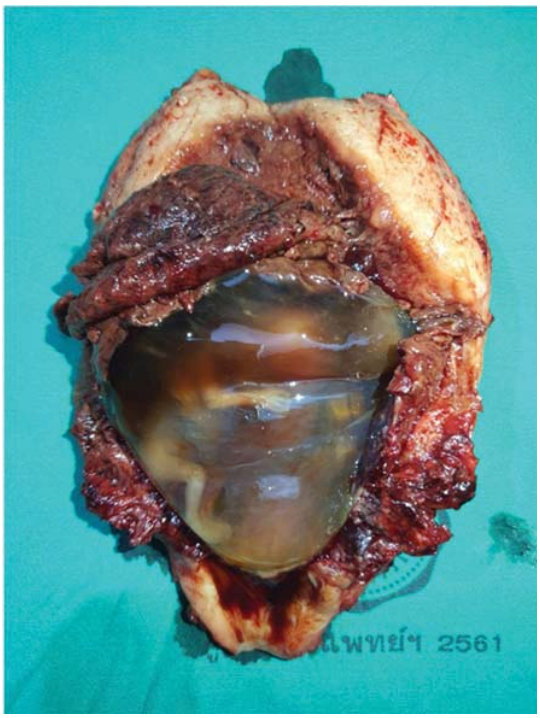

Figure 4. Hysterectomy specimen showing cesarean scar pregnancy.

Uterine rupture is another well-known complication of CSD. It is a complete separation of all three layers of the uterus. Previous uterine scar and especially with scar defect contribute to increased risk of uterine rupture. The incidence is rare but could yield fatal complications to both mother and fetus. Uterine rupture, once happens, may lead to severe fetal distress, need of emergency surgery, hysterectomy, severe uterine bleeding, and protrusion of the fetus and placenta to the abdominal cavity. Recognition of CSD and thinning of RMT help early diagnosis and proper management. Some of the extremely thin RMT may require surgical correction for prevention of uterine rupture in future pregnancy[32,48].

Conclusion

The absolute contributary cause of CSD is prior cesarean delivery. The possible outcomes range from mild setbacks to life-threatening conditions. The best solution is to reduce CS rate. However, in certain circumstances, cesarean delivery is rather mandatory. This unquestionably posts many patients with risk of developing CSD. The antenatal, intraoperative, and postoperative risk factors towards CSD are currently being investigated and there are still conflicting ideas identifying the strongest contributary causes. This is when the early recognition measures will make a difference. This review complies significant complications of CSD together with their proposed pathogenesis and the histopathology behind them. Knowledgeable of the CSD's association to the presenting condition, this will assist healthcare provider in early recognition for prompt investigation and diagnosis.

What is already known on this topic?

CSD is an iatrogenic consequence from cesarean delivery. It could produce mild, irritating symptoms that affect QoL. In rare instances, it causes significant morbidity if not promptly recognized such as cesarean scar pregnancy,

placenta adherens, and uterine rupture.

What this study adds?

First, what we know today is numerous of niche-related complications and their outcome, but rarely any study that compiles all of them together. There are often individual studies and literature reviews that focus on only certain aspects of CSD. This review aims to appreciate important complications in both pregnant and non-pregnant related conditions together with pathophysiology behind them. We hope to bring attention to clinicians on this aspect of disease and improve overall outcomes for patients with CSD.

Secondly, we aim to raise concerns to all physicians and healthcare providers. They are potential representatives to reach out to the society, providing patient education. Together, we hope this could be a preventative measure to reduce CS rates, and ultimately CSD and its consequences.

Potential conflicts of interest

The authors declare no conflict of interest.

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