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Placenta “Accreta, Percreta” as Outcome of Implanted Blastocyst in A Well Healed CS Scar in Comparison to A Dehiscent Scar: A Retrospective 2-Center Study

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Abstract: Background: "Cesarean scar pregnancy" (CSP) is characterized by the attachment of a blastocyst to the site of a previous cesarean delivery scar, typically occurring around seven days after fertilization. The increasing prevalence of cesarean deliveries in recent decades has resulted in a higher frequency of CSP cases. Potential complications associated with Cesarean scar pregnancy encompass morbidly adherent placental conditions (accreta and percreta), uterine rupture, significant hemorrhaging, and premature labor. There is a suspicion that Cesarean scar pregnancies embedded within a dehiscent scar may exhibit distinct behaviors when contrasted with those implanted over a fully healed scar. Nevertheless, there are currently no existing studies that have compared the pregnancy outcomes of Cesarean scar pregnancies situated on a well-healed scar versus those within a dehiscent scar. Objective: Comparison of the outcomes of implanted blastocyst in a well healed cs scar and in to a dehiscent scar. Methods: This study retrospectively examined 20 patients diagnosed with Cesarean scar pregnancy during weeks 5 to 9 of gestation (with a median of 8 weeks) across two medical centers. All Cesarean scar pregnancies were classified into two groups: those situated "atop the well-healed scar" (Group A) and those located "within a dehiscent scar" (Group B), determined based on their initial trimester transvaginal ultrasound assessments. Clinical outcomes, including gestational age at delivery, delivery method, delivery-related blood loss, neonatal weight, and placental histopathology, were compared between these groups using the Mann-Whitney U-test. For patients necessitating hysterectomy and those who did not, myometrial thickness above the placenta was assessed using the Mann-Whitney U-test. Additionally, a correlation analysis using Spearman's correlation examined the relationship between myometrial thickness and gestational age at delivery. Results: Group A comprised 9 patients, while Group B consisted of 11 patients. The gestational age at delivery was notably lower in Group B (median 34 weeks, ranging from 20 to 36 weeks) compared to Group A (median 38 weeks, ranging from 37 to 39 weeks), with a significant difference (p=0.001). Within Group A, 5 patients delivered via cesarean section (with a normal placenta), and one underwent a cesarean-hysterectomy due to placenta accreta. In Group B, 10 patients required cesarean-hysterectomy for placenta increta/percreta, and one patient underwent gravid-hysterectomy due to vaginal bleeding at 20 weeks. While blood loss was higher in Group B (median 1200ml, ranging from 600-4000ml) compared to Group A (median 700ml, ranging from 600-1400ml), this difference did not reach statistical significance (p=0.117). Notably, the myometrium was significantly thinner in the group of patients who needed hysterectomy (median 1mm, ranging from 0-2mm) than in those who did not require hysterectomy (median 5mm, ranging from 4-9mm), with a statistically significant difference (p=0.001). Furthermore, there was a positive correlation between myometrial thickness and gestational age (r=0.820, p<0.0005), indicating that myometrial thickness increased with advancing gestational age. Conclusion: Individuals with Cesarean scar pregnancy located "atop the properly healed scar" experienced significantly improved results in contrast to individuals in whom the CSP was located "within the dehiscent scar." Myometrial thickness measuring under 2mm in the initial trimester ultrasound is linked to morbidly adherent placenta (accreta and percreta) during delivery.

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1. Introduction

Cesarean scar pregnancies pose a serious and potentially life-threatening complication, especially for women who have previously undergone cesarean deliveries.[1] The incidence of these pregnancies has been on the rise in recent decades, paralleling the increasing frequency of cesarean sections.[2] Shockingly, the estimated rate of Cesarean scar pregnancies is around 1 in every 1800 to 2000 pregnancies following a prior cesarean delivery.[3] What's particularly noteworthy is that a significant portion, approximately 52%, of patients experiencing Cesarean scar pregnancies had only undergone a single cesarean delivery in their obstetric history.[4]

Typically, individuals diagnosed with Cesarean scar pregnancies opt for pregnancy termination due to the well-documented and potentially life-threatening complications linked to this condition, as extensively detailed in existing medical literature.[5] Extensive research efforts have yielded a plethora of diverse treatment approaches aimed at achieving the goal of safely terminating Cesarean scar pregnancies.[6] Notably, an innovative method employing a double cervical ripening balloon, introduced as an alternative to surgical procedures for ending these pregnancies, was first introduced in 2012.[7]

Since the publication of this groundbreaking technique, various other treatment methods and their efficacy have been explored, including the utilization of methotrexate, high-intensity focused ultrasound, hysteroscopic resection, and robotic resection.[8] The complications associated with Cesarean scar pregnancies are wide-ranging and can include the development of morbidly adherent placenta, uterine rupture, severe hemorrhaging, fetal demise, premature birth, and the necessity for cesarean-hysterectomy.[9] Despite the substantial risks involved, an increasing number of patients are choosing to continue their pregnancies rather than pursuing termination.[10]

Providing counsel to patients who decide to continue their pregnancies is an intricate challenge, largely due to the limited scientific evidence available in this field.[11] A debate persists within the medical community regarding the true extent of morbidity associated with cesarean section scars.[12] Due to their relatively infrequent occurrence, cesarean section scars have proven to be a challenging subject for comprehensive study.[13] Much of our current understanding of the natural progression of cesarean section scars relies on isolated case reports or small case series.[14] It is possible that there is a tendency to overstate the severity of risks linked to cesarean section scars, potentially influenced by publication bias and selective reporting.[15]

It's worth noting that the most severe cases, those progressing to morbidly adherent placenta, are often the ones that receive attention and documentation.[16] Conversely, cases with favorable outcomes associated with cesarean section scars may have been underreported and less recognized.[17] Cesarean scar pregnancies manifest across a broad spectrum, spanning from partial implantation over the scar to full implantation within the dehiscent area left behind at the site of a prior cesarean delivery.[18] In certain instances, these pregnancies may even extend into the vesico-uterine interphase or the parametrium. Importantly, pregnancies fully implanted within a dehiscent scar exhibit distinct behaviors compared to those situated atop a well-healed scar.[19]

The implications of this wide-ranging spectrum of Cesarean scar pregnancy presentations are twofold. Firstly, it complicates the process of comparing various studies investigating Cesarean scar pregnancies with differing implantation sites. Secondly, the individual risk of adverse outcomes for patients is closely tied to the specific site of placental implantation.[20] Consequently, the primary objective of this study was to

scrutinize pregnancy outcomes in Cesarean scar pregnancies, with a particular emphasis on their implantation site concerning the scar, which was categorized as either "at the dehiscent scar" or "at the well-healed scar." This research aims to shed light on this complex and critical aspect of maternal health.

2. Methods

This retrospective study, which received approval from the Institutional Review Board (IRB), was conducted across two medical centers. The primary objective was to investigate Cesarean scar pregnancies diagnosed during the first trimester within the timeframe of 2022 to 2023. A crucial aspect of this study was the provision of evidence-based counseling to all patients, irrespective of their presenting symptoms. These symptoms could range from being asymptomatic to experiencing bleeding or pain. Patients were presented with the latest and most relevant evidence regarding Cesarean scar pregnancies, and their choices regarding their pregnancies were highly respected. The study focused exclusively on patients who opted against pregnancy termination and instead chose to proceed with their pregnancies.

It's important to note that prior research had already highlighted Cesarean scar pregnancies as a potential precursor to morbidly adherent placenta, but these earlier studies did not specifically delve into distinguishing between placental implantation "in the dehiscent scar" and "on the well healed scar." To identify Cesarean scar pregnancies, specific diagnostic criteria were employed. These criteria encompassed the presence of a gestational sac implanted eccentrically within the lower uterine segment, precisely at the site of the previous cesarean scar. Additionally, diagnostic indicators included an empty uterine cavity and cervical canal, a thin or absent myometrial layer covering the scar region, and the detection of a robust vascular pattern in the vicinity of the cesarean scar and the placenta during Doppler ultrasound examinations.

To ensure the accuracy of the diagnoses, initial sonograms of each patient were meticulously reviewed. This task was entrusted to experienced healthcare providers, both renowned for their expertise in diagnosing and managing Cesarean scar pregnancies. Notably, these reviewers assessed the ultrasound images without any knowledge of the eventual pregnancy outcomes. Following this initial evaluation, patients were categorized into two distinct groups based on the location of the placenta. Group A was defined by the placenta's partial or complete implantation on top of a well-healed scar, as illustrated in Figure 1. In contrast, Group B was characterized by the placenta's implantation within a deficient or dehiscent scar, as depicted in Figure 2.

Comparative analyses between the two groups involved the assessment of maternal age, gestational age at diagnosis, and the number of prior cesarean deliveries. These analyses were conducted using the Mann-Whitney U-test. Additionally, the study measured the minimum myometrial thickness overlying the placenta and documented the gestational age at which Cesarean scar pregnancies was diagnosed. Subsequent sonographic evaluations conducted in the second and third trimesters were scrutinized for signs indicative of morbidly adherent placenta. These signs included the presence of vascular lacunae, interrupted bladder lines, myometrial thinning, and increased vascularity in the utero-vesical region.

Patient records were exhaustively reviewed to gather data on demographics and pregnancy outcomes. Clinical outcomes were thoroughly compared between Group A and Group B using the Mann-Whitney U-test. The parameters analyzed included the mode of delivery (gravid-hysterectomy, cesarean delivery, or cesarean-hysterectomy), gestational age at delivery, blood loss during delivery, antepartum complications, histopathological findings, and neonate weight. Furthermore, the study examined the myometrial thickness overlying the placenta in patients requiring hysterectomy versus

those who did not. This comparison was facilitated by the Mann-Whitney U-test. Lastly, Spearman's correlation was employed to explore the relationship between myometrial thickness and gestational age at delivery.

3. Results

During the course of this study, a total of 20 patients who opted to continue their pregnancies were actively enrolled. These participants were equally distributed between two medical institutions, namely Kasr Alaini University Hospital (KAUH) and Ain-Shams University Hospital (ASUH), with each hospital contributing 10 patients to the study. Among these patients, nine were assigned to group A, while the remaining 11 were allocated to group B, as indicated in Table 1. It's noteworthy that group A comprised individuals with placental implantation "on the well healed scar," whereas group B consisted of those with placental implantation "in the weak scar."

Maternal age did not exhibit any statistically significant divergence between the two groups. Group A had a median maternal age of 34 years, spanning from 20 to 42 years, while group B showed a median maternal age of 35 years, ranging from 27 to 42 years (p=0.88). Similarly, the median gestational age at diagnosis demonstrated no significant variance, with group A diagnosed at a median of 8 weeks (within a range of 6 to 9 weeks' gestation) and group B diagnosed at a median of 7 weeks (within a range of 5 to 9 weeks' gestation) (p=0.679).

Case	GA at diagnosis (weeks)	Age	myometrial thickness (mm)	N° prior CD	GA at delivery (weeks)	Delivery mode	Neonate weight (g)	Blood loss (ml)	Units of PRBC
"on the scar"									
1	9	31	4	1	38	CD	3140	1000	0
2	8	42	8	2	38	CD	3510	700	0
3	8	20	5	1	39	CD	3569	700	0
4	7	36	9	2	39	CD	3090	700	0
5	6	30	4	2	38	CD	2900	600	0
61	8	42	2	1	37	CH	3300	1400	0
"in the niche"									
7	6	32	1	2	35	CH	2550	800	0
8	8	29	2	1	36	CH	2850	1000	0
92	7	42	0	1	32	CH	1900	3000	5
10[2]	9	27	1	1	36	CH	2450	1100	0
11	7	35	2	2	34	CH	2650	1300	2
12[3]	9	34	2	1	33	CH	2050	4000	4
13	8	39	1	1	34	CH	2550	3000	6
14[2]	5	31	0	1	20	GH	270	600	0
15	6	39	1	4	34	CH	2650	600	0
16	9	37	1	3	35	CH	2400	1500	2
17	7	38	1	1	35	CH	2350	1200	2

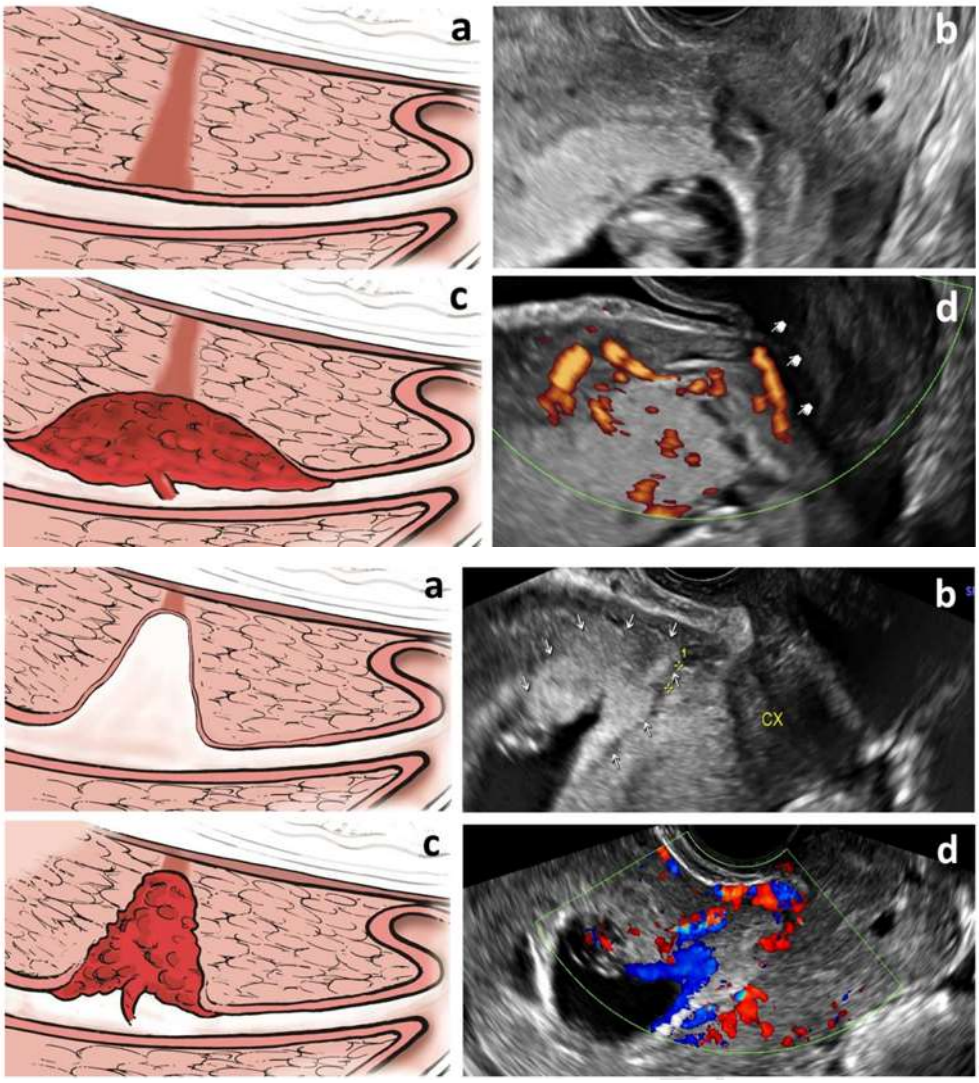
In terms of the number of prior Cesarean Deliveries (CD), both patient groups exhibited similar statistics. Group A patients had a median of 1.5 prior CD, ranging from 1 to 2 prior CD (p=0.884), while group B patients displayed a median of 1.0 prior CD, with a wider range spanning from 1 to 4 prior CD (p=0.884).

Significantly, there was a noteworthy statistical contrast in terms of gestational age at delivery between the two groups. Group B presented with a considerably lower median gestational age at delivery, standing at 34 weeks, with a range of 20 to 36 weeks, in stark contrast to group A, which exhibited a median gestational age at delivery of 38 weeks, within a range of 37 to 39 weeks (p=0.001). Moreover, neonatal weight notably favored group A, with a median of 3220 grams, ranging from 2900 to 3570 grams, while group B had a median neonatal weight of 2450 grams, within a range of 270 to 2850 grams (p=0.001).

Of paramount importance, group A patients displayed no sonographic indications of morbidly adherent placenta, as visually represented in Figure 3. Additionally, group A experienced no antepartum complications. Within group A, modes of delivery

encompassed 5 cases (83%) of Cesarean Delivery, featuring the utilization of the Crédé maneuver (manual fundal pressure for aiding placental delivery) in placental expulsion, and 1 case (17%) necessitated a cesarean-hysterectomy due to incomplete placental removal and uncontrollable hemorrhage. Remarkably, the patient who underwent cesarean-hysterectomy had an initial myometrial thickness of only 2mm as observed during the first trimester ultrasound examination. Histological analysis further confirmed partial placenta accreta in a small region.

In contrast, group B underwent sonographic assessments during the second and third trimesters, all of which raised significant suspicions of morbidly adherent placenta in every patient, as visually depicted in Figure 4. Consequently, all group B patients ultimately required hysterectomy. Specifically, 10 out of the 11 patients in group B (91%) underwent cesarean-hysterectomy, and placenta increta or percreta was histologically confirmed in these cases. One of these cesarean hysterectomies was conducted as an emergency procedure in response to vaginal bleeding occurring at 32 weeks. Furthermore, 1 patient (9%) in group B underwent a gravid-hysterectomy due to severe vaginal bleeding at 20 weeks, with histology confirming placenta percreta.



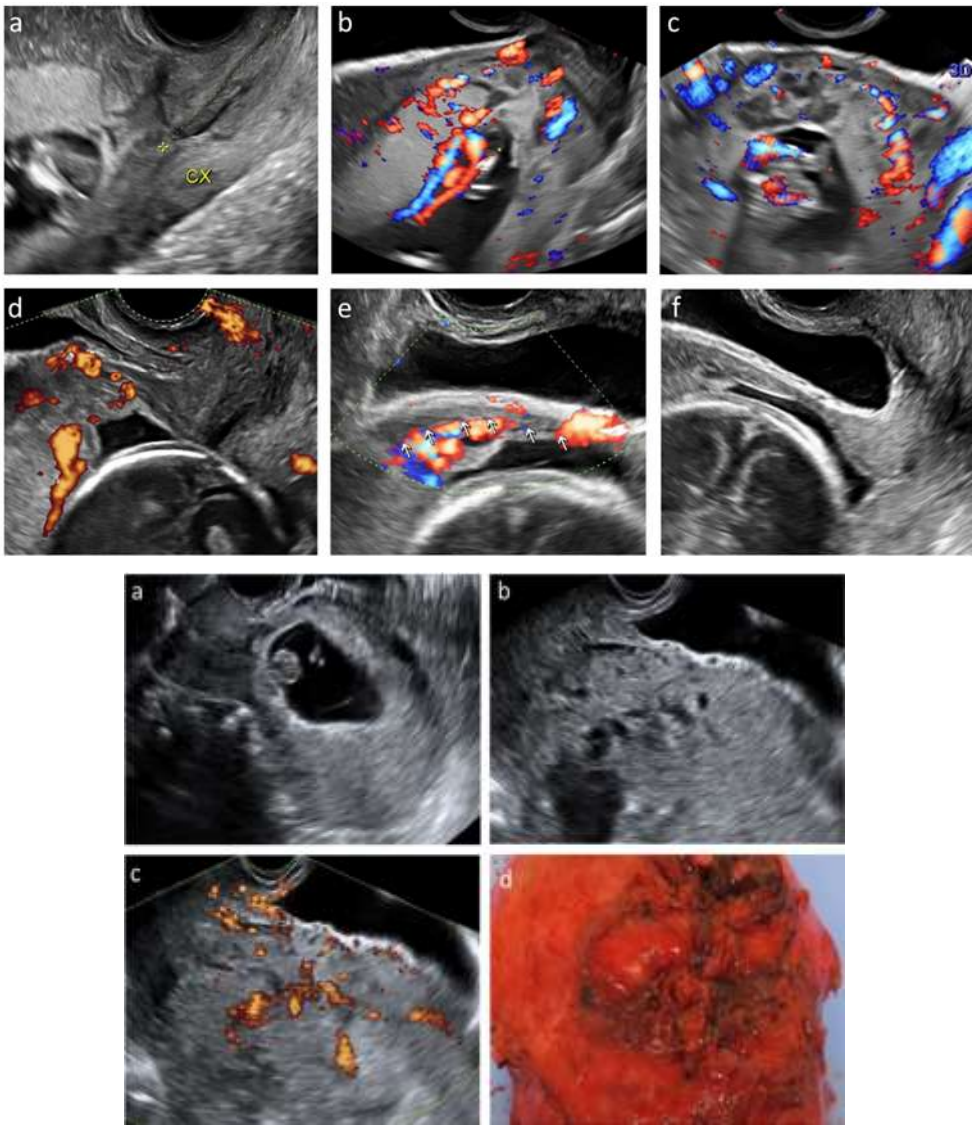


Figure 1: Cesarean scar pregnancies (CSP) implanted “on the scar” Figure 1: Image of a well healed, non-deficient cesarean scar (a). Grey scale ultrasound (b) and color illustration (c) of the placenta implanted “on top of” the scar. Power Doppler ultrasound image showing the rich vascular pattern in the area of the scar (d). Figure 2: Cesarean scar pregnancies (CSP) implanted “in the niche”. Figure 2: Image of a dehiscent cesarean scar (“niche”) (a). Grey scale ultrasound (b) and color illustration (c) of the placenta implanted “in the niche”. Power Doppler ultrasound image showing the rich vascular pattern in the area of the scar (d). Figure 3: Example of a patient with CSP implanted “on the scar” with a normal placenta at delivery. Figure 3: Images of case n° 3: Grey scale image of them placenta implanted “on the scar” at 10 weeks (a). Color Doppler evaluation of the placenta at 14 weeks (b and c). Image of the placenta and cervix at 22 weeks (d). At 28 weeks the placenta moved upwards (e). At 32 weeks no signs of morbidly adherent placenta at the site of the scar (f). Figure 4: Example of a patient with cesarean scar pregnancy (CSP) implanted “in the niche” with placenta percreta at delivery. Figure 4: Images of case n° 16: Grey scale image of CSP implanted “in the niche” at 9 weeks. In the second trimester signs of morbidly adherent placenta are demonstrated (b, c): vascular lacunae, interrupted bladder line, myometrial thinning, and utero-vesical hypervascularity. Uterus specimen after delivery (d).

Concerning blood loss during delivery, group B experienced an increase, though this difference did not reach statistical significance when compared to group A. Group B exhibited a median blood loss of 1200 milliliters, with a range spanning from 300 to 4000 milliliters, while group A reported a median blood loss of 700 milliliters, ranging from 600 to 1400 milliliters (p=0.117).

Notably, in group B, where the demand for cesarean-hysterectomy was higher, 3 out of 11 patients (27%) underwent prophylactic iliac artery occlusion during delivery. The decision to proceed with iliac artery occlusion was made by the overseeing surgeon in charge of these cases. Furthermore, 6 out of 11 patients (55%) in group B required blood transfusion, with a median of 2 units of packed red blood cells administered, spanning from 2 to 6 units.

Crucially, myometrial thickness overlying the placenta emerged as a significant parameter. This thickness was statistically thinner in patients necessitating hysterectomy within the group, with a median of 1mm and a range of 0 to 2mm, compared to those who did not require hysterectomy, which had a median thickness of 5mm and a range spanning from 4 to 9mm (p=0.001). Furthermore, the analysis unveiled a positive correlation between myometrial thickness and gestational age, with an r-value of 0.820 and a p-value of less than 0.0005, underscoring its clinical relevance.

4. Discussion

The findings from our study underscored a critical distinction in the outcomes of patients with Cesarean scar pregnancy (CSP) based on the site of placental implantation. Specifically, those with CSP implanted "on the scar" experienced notably better results in comparison to those with CSP implanted " in the dehiscent scar," as evidenced by prior research.[2,7,11]

A significant revelation from our study was that all patients who achieved a favorable outcome had a myometrial thickness of 4mm or greater during their first trimester ultrasound examination. This observation highlights the potential predictive value of myometrial thickness as an early indicator of CSP prognosis. However, an intriguing contrast emerged when examining the case of a single patient with CSP "on the scar" who unfortunately developed morbidly adherent placenta. In this instance, the myometrial thickness measured a mere 2mm, emphasizing the need for vigilant monitoring and early intervention, even when the myometrial thickness falls within the atypical range.[21]

In stark contrast, the cohort of patients with CSP implanted " in the dehiscent scar" faced a different trajectory. Each of the 11 patients in this group ultimately required hysterectomy due to the development of morbidly adherent placenta. Strikingly, their myometrial thickness during the first trimester ultrasound was consistently measured at 2mm or less. This finding accentuates the association between thinner myometrial measurements and the heightened risk of morbidly adherent placenta in cases where the implantation occurs within the deficient or dehiscent scar, commonly referred to as the " in the dehiscent scar."[3, 10, 15]

Our study clearly illuminated the distinct clinical outcomes that emerged when comparing patients with Cesarean scar pregnancy (CSP) implanted "on the scar" versus those with implantation " in the dehiscent scar." Moreover, we found suggestive evidence that myometrial thickness could serve as a valuable indicator for predicting adverse outcomes in CSP cases. Notably, all patients in our cohort who developed morbidly adherent placenta exhibited a myometrial thickness of 2mm or less during their initial ultrasound examination.[14, 18, 20]

The categorization of CSP into these two distinct groups, combined with the measurement of myometrial thickness, could offer a promising approach to tailoring patient counseling and management. For instance, patients with CSP implanted "on the scar" and a myometrial thickness measuring 4mm or more may be considered favorable candidates for expectant management. Expectant management in CSP cases has been

associated with the potential for delivering a live-born neonate, albeit with a significant risk of requiring hysterectomy, as noted in previous research.[4, 9, 11, 12, 18]

In our study, an impressive 94.1% of patients managed expectantly successfully delivered a live neonate. This outcome aligns closely with the findings of Zosmer et al., where all patients managed expectantly gave birth to live neonates, demonstrating a substantially higher rate than the study conducted by Michaels et al., which reported a live birth rate of only 62.5%. However, it's worth noting that in our study, 70.5% of patients ultimately required hysterectomy due to morbidly adherent placenta. While this rate was lower than what was observed in some other studies where all patients necessitated hysterectomy, it still represented a significant proportion requiring this intervention. For instance, Michaels et al. reported a hysterectomy rate of 37.5%.[3,8,13]

Our study also shed light on historical insights from as far back as the late 1900s, where large retrospective studies had already explored the relationship between prior cesarean delivery (CD) and morbidly adherent placenta. These studies revealed that when the placenta was implanted directly over a uterine scar, the rate of morbidly adherent placenta ranged from 30% to 40%. More recently, several articles have discussed the issue of CSP implantation over the scar from a previous CD. However, none of these previous studies precisely assessed the exact site of placental implantation, which could potentially account for the variations in reported incidence rates.[15, 16]

Ultimately, the findings from our study corroborate earlier suspicions that the site of implantation in CSP cases could indeed influence their natural outcomes. This underscores the importance of a nuanced approach to CSP management, with a keen focus on individualized patient care and early risk assessment based on factors such as myometrial thickness and implantation site.[20, 21]

Implications for treatment

The optimal timing for diagnosing a Cesarean scar pregnancy (CSP) falls within the window of 6 to 8 weeks' gestation. This specific timeframe is preferred because it allows for a clearer visualization of the developing placenta through ultrasound imaging. During these early weeks, the structural details of the placenta are more discernible, aiding in the accurate identification of CSP. Additionally, we recommend obtaining at least three ultrasound images of the utero-placenta interphase during this diagnostic process.[22]

Among these collected images, it is crucial to select the one that reveals the thinnest myometrial thickness overlying the placenta. Employing 3D ultrasound tomography can be particularly advantageous in pinpointing the thinnest myometrial thickness with precision. Early diagnosis is paramount for several reasons. Firstly, it offers patients the opportunity to make informed decisions about their pregnancy, including whether to continue or terminate. In cases where termination is chosen, procrastination can lead to increased risks for complications, making timely diagnosis a critical factor in patient care.[23]

Moreover, early diagnosis facilitates comprehensive counseling for patients regarding both ante- and intrapartum complications associated with CSP. Patients are educated about the potential risks and complications, allowing them to make decisions aligned with their preferences and medical advisories. Additionally, if a patient elects to proceed with the pregnancy, early diagnosis permits appropriate surveillance throughout gestation. This ongoing monitoring ensures that any developing complications are identified promptly, and intervention can be initiated if necessary, ultimately enhancing patient safety.[24]

Furthermore, early diagnosis sets the stage for improved planning and preparation for a safer delivery. Medical facilities can take proactive measures to ensure patient safety by assuring the availability of a well-supplied blood bank, which is crucial for addressing potential hemorrhagic complications. Additionally, the presence of skilled surgical personnel can be ensured, facilitating immediate access to medical expertise in the event of an emergency.[25]

The relation between clinical performance, malpractice, and the outcomes of placenta "accreta, percreta" as a result of implanted blastocyst in a well-healed CS scar compared to a dehiscent scar lies in the context of evaluating the effectiveness and potential risks associated with the management of cesarean scar pregnancies.

Clinical performance evaluation in this study involves assessing the outcomes of cesarean scar pregnancies in two distinct groups: those situated "atop the well-healed scar" and those located "within a dehiscent scar." This evaluation includes measures such as gestational age at delivery, delivery method, delivery-related blood loss, neonatal weight, and placental histopathology, aiming to determine which group yields better clinical outcomes for patients.

Malpractice prevention comes into play through the careful monitoring of treatment outcomes and potential complications associated with cesarean scar pregnancies. The study examines the occurrence of adverse events such as uterine rupture, significant hemorrhaging, and the need for cesarean-hysterectomy due to placenta accreta or percreta in either group, aiming to identify any potential risks that could lead to malpractice claims or patient harm.

By comprehensively evaluating the treatment outcomes and potential complications, healthcare providers can make informed decisions regarding the management of cesarean scar pregnancies, ultimately contributing to both improved clinical performance and reduced risk of malpractice incidents in the care of these complex cases.

5. Conclusion

In conclusion, the findings of our study contribute valuable insights into risk assessment and counseling strategies for CSP patients. By recognizing the differences in outcomes based on implantation site and myometrial thickness, healthcare providers can offer more personalized care plans. Additionally, identifying candidates for expectant management among CSP patients can lead to less invasive and more patient-centered approaches to treatment, aligning with individual preferences and optimizing overall care.

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