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Ultrasonography of the uterus within 6 weeks following Cesarean section

Research Article

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Abstract: Objective. The aim of the study was to compare the integrity of the uterine scar after elective and urgent Caesarean section (CS) and specify a technique to describe the sonographic findings. Methods. Ultrasound examination was performed in 131 women at 48 and 96 hours (transabdominal), and 6 weeks (transvaginal) after CS. We assessed numerous clinical and ultrasound variables. To quantify the severity of the scar defect, we describe a "dehiscence risk coefficient" (DRC). Results. Mean myometrial thickness above the scar and below the scar 6 weeks after CS was 12.1 ± 2.5 mm and 11.5 ± 2.5 mm, respectively. The mean scar thickness after elective and urgent CS was 7.68 ± 2.27 mm and 4.9 mm ± 2.21 mm, respectively. The cut-off value (5th percentile) for the CS scar thickness and for DRC was 2.9 mm and 0.25, respectively. DRC less than 0.25 was elected to consider a severe scar defect, which was diagnosed in 14/131 (10.7%) patients, 1.5% after elective CS and 9.2% after urgent CS. ($P < 0.001$). Conclusions. Dehiscence risk coefficient measurement six weeks after delivery allows for precise quantitative description of the CS scar. Urgent CS has a higher risk for a severe scar defect.

Keywords: *Ultrasound • Cesarean section • Cesarean section scar • Dehiscence risk coefficient • Puerperium*

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1. Introduction

Cesarean section (CS) is associated with an increased risk of postpartum hemorrhage and abnormal healing of the CS scar [1-3]. Abnormal healing of the CS scar can lead to increased risk of uterine rupture in subsequent pregnancies of the previous CS scar, abnormal placental implantation (placenta praevia, accreta, percreta) and ectopic pregnancy in the previous CS scar [4-6]. The frequency of these pathological conditions is reported between 0.04–3.8%. Abnormal implantation is a life threatening condition, particularly in women after previous CS [7-9].

Sonographic measurement of the lower uterine segment thickness is a strong predictor for uterine scar defect in women with prior Caesarean section [10]. However, the results of studies are inconsistent and no cut-off value of the uterine scar thickness can be recommended [11].

Only a few sonographic studies provide measurements of the uterus soon after CS [12-14]. However, none of these studies offer uterine dimensions in all

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three orthogonal planes measured by ultrasound at 48 hours, 96 hours and 6 weeks after CS and the ultrasound evaluation of the CS scar 6 weeks after CS.

Morphological changes of the postpartum uterus can be monitored by sonographic visualization and biometry. The aim of this study was to provide measurements of the uterus in the early and late postpartum periods, to define the sonographic characteristics of the CS scar within 6 weeks after surgery.

2. Methods

Study population

From June 2009 to June 2010, we enrolled in this prospective longitudinal study 131 women who delivered by CS. We registered demographic and actual clinical characteristics of each woman. Our study protocol was approved by the hospital ethics committee and the patients were provided written informed consent.

Ultrasound examination

Ultrasound examinations were performed at 48 hours, 96 hours (transabdominal), and 6 weeks (transvaginal) after CS in all 131 women. All scans were performed by a single operator (E.D.) with the Voluson 730 Expert (GE Healthcare, Zipf, Austria) and convex 4-8 MHz abdominal (RAB 4-8L) and 5-9 Mhz transvaginal (RIC 5-9) transducers.

At 48 and 96 hours after CS

Uterine length, uterine height and the maximum dilatation of the uterine cavity were measured. The women were asked to have an empty urinary bladder and were examined in supine position. The probe was placed in the umbilicus perpendicular to the long axis of the uterus, with only gentle pressure on the uterine fundus. We used low ultrasound frequency (4 MHz) to be able to visualize the entire uterus. We magnified the image so that the uterus with the adjacent urinary bladder and pouch of Douglas occupied the whole screen. Uterine length was measured from the external os of the cervix to the fundus (Figure 1). Uterine height was measured at the mid-length of the uterine corpus. Uterine width was measured in a transverse view halfway along the length of the uterus. (Figure 2).

6 weeks after Cesarean section

The ultrasound examinations 6 weeks after CS were performed transvaginally. We measured the uterine length and height, the maximum dilatation of the uterine cavity, the thickness of the myometrium proximal and distal to the CS scar, and the thickness of the scar (Figure 3). To define the severity of the scar defect, we postulated the "dehiscence risk coefficient" (DRC), which is calculated as a ratio between the thickness of the scar (*s*) in and

Figure 1. Sagittal view of the uterus with highlighted margins obtained transabdominaly 48 hours after CS. Ut-H, uterine height; Ut-L, uterine length. Blue – myometrium. Purple – scar.

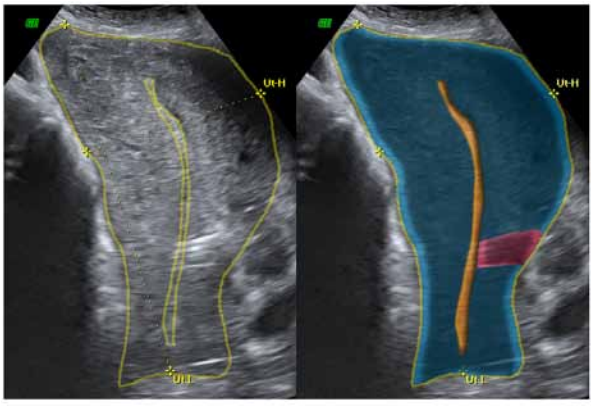


Figure 2. Transverse view of the uterus obtained transabdominaly 48 hours after CS. Ut-W, uterine width.

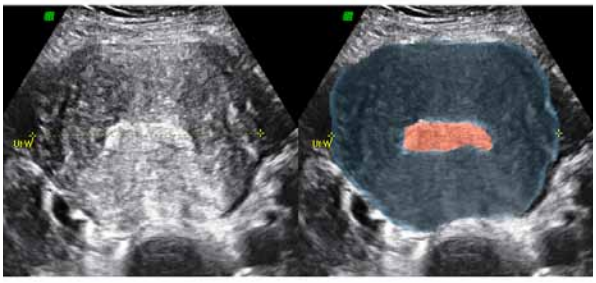
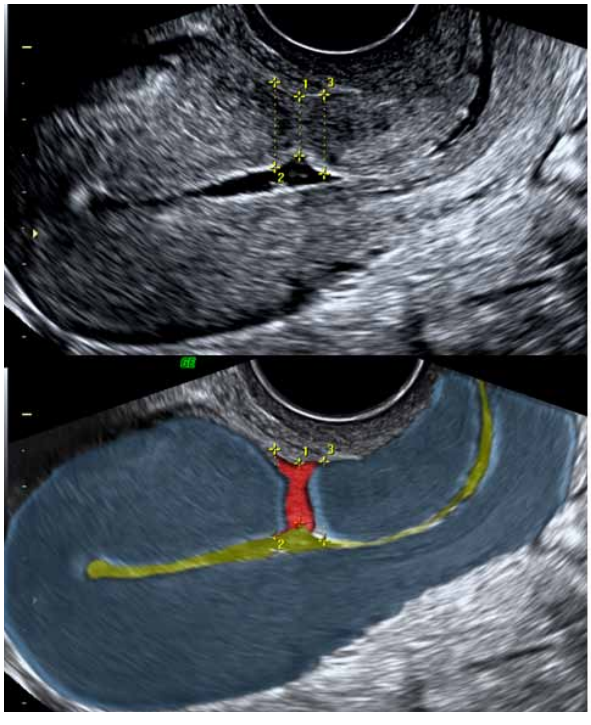


Figure 3. Sagittal plane of the uterus obtained transvaginally 6 weeks after CS. The thickness of the CS scar (1), the thickness of the myometrium proximally (2) and distally (3) to the CS scar.



the thickness of the myometrium adjacent to the defect (mean thickness of the myometrium proximal (p_m) and distal (d_m) the scar): DRC = s/ (p_m + d_m)*0.5

Cesarean section

Routine antibiotic prophylaxis consisting of two grams of cefazoline was administered to each woman intravenously prior to skin incision. We used the modified Misgav-Ladach technique with minimal use of instruments and blunt separation of the individual layers of the abdominal wall (Joel-Cohen laparotomy) [15]. In this approach, the uterus is opened by digital stretching of the uterine incision, located above the unprepared uterovesical fold. Uterotonics (5 IU units of oxytocin) were given intravenously as a bolus, before manual removal of the placenta. Uterine incision was sutured with a single layer of self-locking running absorbable triclosan-coated polyglactin 910 suture (Vicryl Plus 0, Ethicon, Belgium). Thorough cleansing of the abdominal cavity using a suction unit was performed. The visceral and parietal peritoneum was not sutured. The rectus aponeurosis was sutured with a simple running stitch of the same material. The skin was closed with a subcuticular continuous stitch of Monocryl Plus (Ethicon, Belgium). The urinary bladder was catheterized with a Foley catheter for 24 hours after surgery. All CS were performed by a skilled surgeon (E.D.).

Elective CS was performed prior to labor. Urgent CS was defined as an intrapartum CS with regular uterine contractions (more than 1 in 5 minutes, cervical dilatation more than 3 cm).

3. Statistical analysis

Statistical analysis was performed using PASW Statistics 18 (SPSS, Chicago, IL, USA). Descriptive statistics are presented as mean values with standard deviation (SD) or range. Categorical data are presented as absolute numbers with percentages. T-test was used to determine the statistical significance of differences in uterine dimension measurements. The chi-square test was used for comparison of CS scar thickness after elective and urgent CS. A percentile definition of normal was used to express the normal range for uterine dimensions, CS scar thickness and for the dehiscence risk coefficient (DRC). All values in the lower and upper 5% of the total range were defined as uncommon. The cut-off value for the CS scar thickness and for the DRC was specified as the 5 percentile. P < 0.05 was considered to be statistically significant.

4. Results

The median age was 29 years (range 23-40). Repeat CS was performed in 44 women (33.6%). Mean birthweight was 3331 g (± 507), gestational age 39 weeks (range 36-40). Percentage of urgent CS, breech positions and PROM is shown in Table 1.

All 131 patients after CS underwent three consecutive ultrasound examinations. Of the 131 women, 44 (33.6%) had undergone “urgent” CS, and 87 (66.4%) had undergone elective CS. (Table 1) Ultrasound measurements of the uterine length, width, height, and cavity dilatation performed at the defined periods (48 hours, 96 hours and 6 weeks after CS) are shown in Table 2. Uterine dimensions showed significant decrease in all parameters (p < 0.001), except for the dilatation of the uterine cavity at 96 hours after CS. Dilatation of the uterine cavity 96 hours after CS was significantly higher at 96 hours than at 48 hours after CS (p < 0.001) .

At 6 weeks after CS transvaginal ultrasound examination was performed to assess the CS scar and uterine dimensions. The mean thickness of the myometrium proximal and distal to the CS scar were 12.14 ± 2.4 mm

Table 1. Percentage of urgent CS, fetal breech positions and PROM >2 hours.

	Cesarean section	Fetal position		Amniotic fluid leakage (hours)		
	Urgent	elective	cephalic	breech	< 2	> 2
N (%)	44 **(33.6)**	87**(66.4)**	112 **(85.5)**	19 **(14.5)**	96 **(73.3)**	35 **(26.7)**

Table 2. Uterine dimensions obtained 48 hours, 96 hours (transabdominal), and 6 weeks (transvaginal) after Cesarean section.

n=131	48 hours mean, ± SD (mm)	96 hours	6 weeks
Length	**155.6** ± 14.6	**141.2** ± 10.5	**76.6** ± 6.7
Width	**109.9** ± 14.1	**103.8** ± 12.3	**51.9** ± 6.3
Height	**79.6** ± 10.4	**77.0** ± 8.1	**39.4** ± 2.6
Cavity dilatation	**10.6** ± 6.5	**11.9** ± 6.5	**6.6** ± 3.0
p*	p < 0.001	p < 0.001	p < 0.001

*t-test

Table 3. Comparison of dehiscence risk coefficient after elective and urgent Cesarean section.

	Cesarean section (n= 131)				
	Elective	Urgent	p*		
	N	**%**	N	**%**	
DRC ≥ 0.25	85	**64.9**	32	**24.4**	p < 0.001
DRC ≤ 0.25	2	**1.5**	12	**9.2**	p < 0.001
Total	87	**66.4**	44	**33.6**	

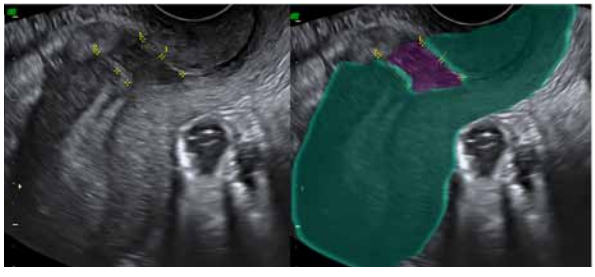
**chi-square test; DRC, dehiscence risk coefficient.*

and 11.47 ± 2.52 mm, respectively. The mean thickness of the CS scar was 6.75 ± 2.6 mm. The cut-off values (5 percentile) for the CS scar thickness and for the dehiscence risk coefficient were 2.9 mm and 0.25, respectively. DRC less than 0.25 we elected to consider a severe scar defect. Severe scar defect was present in 14/131 (10.7%) patients. After elective CS, a severe scar defect was present in 2/131 (1.5%) patients and after urgent CS in 12/131 (9.2%) of the patients (p<0.001) (Table 3). The mean scar thickness after elective and urgent CS was 7.68 ± 2,27 mm and 4.9 mm ± 2.21 mm, respectively.

In one case we observed a bladder flap hematoma with dimensions 78 x 62x 60 mm at 48 hours and slightly decreasing to 75 x 59 x 50 mm at 96 hours after CS (Figure 4). The treatment was conservative. At 6 weeks after CS there was almost complete resorption with a residual oval echogenic mass (24 x 11 x 11 mm) located over the CS scar. The CS scar itself was completely dehiscent (Figure 5).

Figure 4. Bladder flap hematoma 96 hours after Cesarean section. The midsagittal plane of the pelvis showing large hypoechogenic mass (hematoma) behind urinary bladder.

Figure 5. Complete dehiscense of the CS scar visualized 6 weeks after CS as a hypoechogenic loss of the myometrial continuity.



5. Discussion

We are presenting a noninvasive technique for the assessment of cesarean section scar using the dehiscence risk coefficient.

During the first 6 weeks after delivery, the anatomy and physiology of the female reproductive system returns to the non-pregnant state, but the healing of the Caesarean section scar takes several more months. Exact data with supporting evidence about the time needed to complete the remodeling of the uterine scar are missing. There might be differences not only in the types of closure, but also in the genetic predispositions16. Dicle et al. using magnetic resonance imaging have found that remodeling may take longer than 6 months after surgery [17].

Blood clots at the CS scar cause fibroblast proliferation which lays down collagen. The myofibroblast is another specialized fibroblast involved in scarring and contraction. During the normal healing process of the wound, myofibroblasts disappear within the first 30 days but if there is prolonged scar formation, myofibroblasts may be present for a much longer time [18]. A stiff scar with insufficient neoangiogenesis causes impaired perfusion and oxygenation of the tissue [19]. On the other hand, early remodeling of the scar is much more physiologic. We have assessed uterine dimensions early and late in the puerperium. Ultrasound measurements were obtained easily in all patients, although Koskas et al. [13] could not obtain correct measurements in 30% of cases at 24 hours after CS. In fact, the measurement of the uterine length at 48 hours and 96 hours after CS is difficult, because of the extensive size of the postpartum uterus, and the tenderness of the anterior abdominal wall. As a result of our postpartum examination experience, we used a modified transabdominal ultrasound examination technique, with the probe “sitting” on the uterine fundus. The described ultrasound technique is exact, gentle and very quick. Sokol et al. [14] described uterine dimensions within 48 hours after vaginal delivery, and reported mean endometrial stripe thickness was 11 ± 6 mm, mean uterine length was 161 ± 17 mm and mean uterine width was 87 ± 10 mm, which is very similar to our data. Koskas et al. [13] performed ultrasound examination 24 hours after CS and reported mean uterine length was 155 ± 13 mm, mean uterine width was 101 ± 10 mm and mean endometrial thickness was 10 ± 2 mm. Uterine dimensions in our study showed significant decrease in all parameters, except of the dilatation of the uterine cavity at 96 hours after CS. The increased dilatation of the uterine cavity at 96 hours after CS could be explained, by the possibility that 3 days after CS the uterine cavity is filled with colliquated blood clots, which reflect the normal healing process of the uterine cavity. Usually, in 6 weeks after CS the uterine cavity is empty.

The patient with a bladder flap hematoma and subsequent complete dehiscent section scar was a primiparous woman, who delivered a 3850 g neonate by urgent CS due to cephalopelvic disproportion and premature rupture of membranes. Hematocrit (25%) and hemoglobin level (8.2 g/dl) were decreased due to blood loss of about 800 ml. She was febrile on days 1-3 (max. 39.6°C) accompanied by high C-reactive protein

levels (max. 219 mg/L). Antibiotics were administered intravenously for 7 days. At 6 weeks after CS we found a small oval echogenic mass (24 x 11 mm) located over the CS scar, and the CS scar was completely dehiscent (Figure 5). There is a report about laparoscopic treatment of post-CS bladder flap hematoma to prevent abnormal healing of the CS scar during puerperium [20].

Vikhareva et al. [21,22] demonstrated that the risk of a large Cesarean scar defect was higher in cases with longer duration of labor at CS and post-partum anemia. Our data suggest, that emergency CS is also a risk factor for abnormal healing of the CS scar. This finding is in accordance with previous studies [23-25].

In our study, 10.7% of the women had a severe scar defect. Vikhareva et al. [26] and Ofili-Yebovi et al. [9] defined large CS scar defects similarly, and they found severe scar defects in 42% and 10% of their patients, respectively. The different results might be explained by different indication criteria for CS, by diverse surgical techniques or by differences in timing of the ultrasound examination.

In conclusion, morphological changes of the post-cesarean uterus are verifiable by ultrasound. Values (for the CS scar thickness and for the dehiscence risk coefficient) below the 5th percentile may be considered abnormal. We suggest that the DRC smaller than 0.25 should be considered a severe scar defect. This treshold would include only a small proportion of women, which should be assigned in the subsequent pregnancy to a high-risk group. This group of women should be advised to undergo ultrasound examination at 7 weeks´ gestation [27] (to exclude Cesarean scar ectopic pregnancy), and at 38 weeks´ gestation [28] (to evaluate continuity of the lower uterine segment). Incidence of Cesarean scar ectopic pregnancy is about 1 in 2000 pregnancies [29], and early diagnosis is vital to institute uterus-saving therapy. Uterine rupture complicates about 2.4% of the vaginal births after cesarean section [30]. We suppose in any case, that women with severe CS scar defect have much higher risk of uterine rupture by vaginal birth after CS, and that the above percentage does not reflect the risk factors for rupture.

The real risk of severe scar defects and complications in consecutive pregnancies could be confirmed only by a large longitudinal study.

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