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Original Article

New lower segment repairing surgery to control bleeding in repeated caesarean section, a randomized controlled trail

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Abstract: Objective: Bleeding was very common in repeated caesarean section, but most of the existed surgical methods were targeted at atony of the uterine corpus. We attempted to describe a new suturing technique in order to control bleeding from the lower segment of uterus in repeated CS. Methods 110 elective repeated caesarean section (ERCS) patients were included. We randomly assigned them into two groups according to a computer generated randomized block with 55 patients in each group (repair group: new suturing method was performed; control group: classic CS was performed). Intraoperative and postoperative parameters were compared. Results: The repair group was found to be superior to the control group with less blood loss (523.64±253.97 vs 660.00±278.55 g, p=0.008). Although multivariate analysis showed no superiority of this method in reducing the rate of PPH and application of tocolytic agent (adjusted OR 0.90, 95% CI 0.10, 7.91; adjusted OR 0.26, 95% CI 0.06, 1.07; respectively), hospital stay time of the repair group was shorter (adjusted OR 3.96, 95% CI 1.36, 11.56). There were no differences in neonatal Apgar score at 5 minute, surgery time or risk of puerperal morbidity. Conclusion: This new suturing method could reduce blood loss effectively in the lower segment of uterus in ERCS patients. Because of its simplicity of application and less time taken, it should be a preferred choice.

Keywords: Lower segment repairing surgery, repeated caesarean section, postpartum haemorrhage, postoperative complications

Background

Caesarean Section (CS) as an obstetric practice has substantially increased in both developed and underdeveloped countries with time [1-3]. Although huge difference in CS rates existed between nations, the 50th percentile for CS rate was 30% in medical facilities according to a recent multi-country cross-sectional study [1]. There are numerous factors which contributed to an increased CS rate, unnecessary operations were attributable to maternal request, non-evidence-based indications, increasing maternal age and a decline in vaginal birth after caesarean delivery due to the risk of uterine rupture [4]. In the United States, about 30% of pregnant women had their delivery by caesarean section in the past decades [5], the general caesarean section rates varied from 17 to 52% across Europe [6]. This rate differed between nations in Asian geography as well. The CS rate in Korea remained at approximately 36% since 2006 [7]. In Japan, the CS rate was 23.3% in 2008 [8]. In China, the CS rate was 15.8% in 2003 and 46.8% in 2011 with the highest rate of 50.8% in 2008 [9].

This explosion in CS worldwide has, in turn, exacerbated incidence of post-operative complications, especially the long-term complications, such as placental invasion anomalies, intra-abdominal adhesions and endometritis [10]. However, in China and other countries the most common reason for the increasing trend

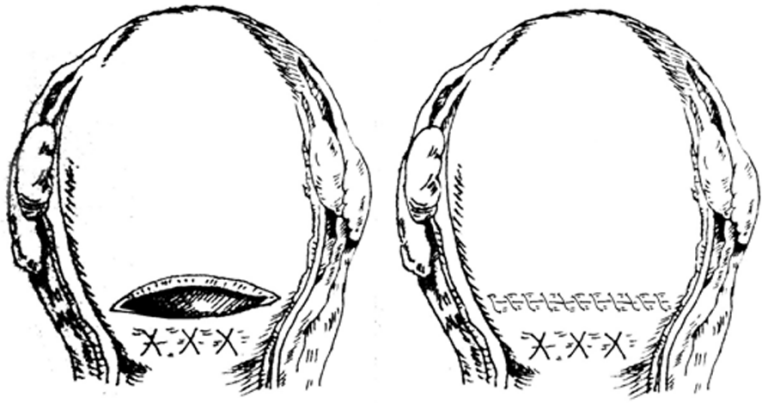

Figure 1. Procedures of the new suture technique. Ligatures like figure "8" were performed in the scar area and then continuous suture of the uterus.

in CS rate is the increasing number of women with prior CS [11, 12]. These long-term complications could bring adverse outcomes. In the repeated caesarean surgery, sometimes doctors were faced with the risks of severe adhesion, injury to adjacent organs and bleeding, specifically which could lead to fatal outcomes. In March 1997, Lynch published his brace suture for controlling bleeding [13]. Since then, more than 10 variants of uterine compressing sutures have been reported. But most of these surgical methods were targeted at atony of the uterine corpus, also limited surgical methods were reported about lower segments atony. Because of the formation of scar tissue, the wall of the lower segment of uterus is very thin and lack normal muscle tissue, damaging the contractility and leading to hemorrhage. This is not rare in repeated CS. With the advent of second child boom happening in China, more women with prior CS and aged above 35 became pregnant again. A study of delivery intention investigation showed older women have the tendency of having CS rather than virginal delivery [14]. Elective repeat cesarean section (ERCS) still be made for many elder mothers in China. In order to control bleeding and promote uterine scar healing, we will introduce a new simple and practical method in repeated CS patients in this study.

Materials and methods

Patient selection criteria

This randomized controlled study was undertaken at West China Second University Hospital of Sichuan University in Chengdu, China after being approved by the Ethics Committee. All singleton pregnancies with gestation above or equal to 39 weeks with one previous caesarean section and ERCS from January 2016 to April 2016 were included in our study. Pregnant women below 20 and above 45 years of age were excluded, considering the possible higher incidences of postpartum hemorrhage (PPH) and other complications in these two age groups [15]. Patients with pregnancy related complications such as intrahepatic cholestasis of pregnancy, gestational diabetes, hypertensive disorders and placental abnormalities were excluded. Pregnant mothers with vital organ dysfunctions before gestation were also excluded. All of our patients received elective surgeries. Patients were excluded if emergency CS were performed.

Patient groups and interventions

There were 110 patients in our study. Patients were allocated randomly into two groups based on a computer generated randomized block (55 patients in each group). Sequence of hospitalization was recoded according to the randomized block and then assignment to different groups was executed. Participants in the repairing group received new suturing method. Participants in the control group received traditional CS only. All patients had the lower uterine segment (LUS) muscular thickness measured by transvaginal ultrasound before ERCS. Two experienced doctors performed surgery. Weighing method was used to guarantee exact blood loss for calculation. After surgery, the vital data, urine output and vaginal bleeding were observed, for the first 24 hours after surgery. If vaginal bleeding was too much, uterine contraction was checked and carboprost trometamol was administered as needed. Blood transfusion was considered according to preoperative hemoglobin and the amount of intraoperative blood loss in patients. All of the participants were followed up at the 6th week in an outpatient clinic after they were discharged from hospital.

Table 1. Baseline maternal characteristics

Characteristic	Repair groupn (n=55)	Control group (n=55)	*p*-Value
Age (y), mean (SD)	37.51±2.62	38.47±3.42	0.100
Insurance, n (%)	44 (80.00%)	42 (76.37%)	0.644
Education, n (%)			
College and above	38 (69.10%)	31 (56.36%)	0.167
Pre-gestation BMI (kg/m^2), mean (SD)	23.11±2.27	22.43±2.28	0.115
Gravidity, n (%)			0.124
≤3	28 (50.91%)	32 (58.19%)	
>3	27 (49.09%)	23 (41.81%)	
Parity, n (%)			0.650
≤2	43 (78.19%)	39 (70.91%)	
>2	12 (21.81%)	16 (29.09%)	
Gestational weeks (week), mean (SD)	39.38±0.38	39.44±0.35	0.372
Scar thickness (mm), mean (SD)	2.21±0.40	2.34±0.36	0.089
Frequencies of CS before, n (%)			
1	44 (80.00%)	39 (70.91%)	0.500
≥ 2	11 (20.00%)	16 (29.09%)	
Time interval from last time CS (year), mean (SD)	5.86±3.58	6.93±3.51	0.115

Abbreviations: BMI, body mass index; SD, standard deviation; CS, cesarean section.

The new suture method

Steps of the new suture technique: The portion of placenta was removed manually, adhesions in the peritoneal reflection were replaced and the bladder and covering peritonea were pushed down to expose the lower segment of uterus. 8 shaped ligatures were performed in the scar dehiscent area in order to increase the thickness and strength of the lower uterine segment, followed by traditional closure of the CS (**Figure 1**).

Data collection

Data of maternal demographics, reproductive and medical history were collected for all women. First trimester ultrasound examination was used to calculate the exact gestational weeks. Our primary outcome were blood loss in the 1st 24 hours and rates of PPH. Secondary outcomes included injuries to adjacent organs, duration of procedure, puerperal morbidity, application of potent tocolytic agent after surgery, length of hospital stay, Apgar score, birthweight and fetal complications such as intrauterine fetal demise. PPH was defined according to the ACOG practice bulletin 2006 [16]. Fetal macrosomia is defined as birth weight ≥ 4000 g.

Statistical analysis

Data were anonymized and entered by double entry method into a customized database. Statistical analysis was performed using SPSS version 19.0 (IBM, Armonk, NY, USA). A two-tailed t test and a chi-squared (X^2) test were used to compare the clinical characteristics between groups. Binary logistic regression analysis was used to compare the maternal and fetal outcomes, in which possible confounding factors (maternal age, gravidity, parity, pre-gestational Body Mass Index (BMI), frequencies of CS and time interval from previous CS) were taken into account. *P* value < 0.05 was considered statistically significant.

Results

Clinical characteristics

A total of 110 women were recruited in the current study. Scar thickness in the repair group was 2.21±0.40 millimeter (mm), scar thickness in the control group was 2.34±0.36 mm. There were no statistically significant differences between the two groups (**Table 1**).

Blood loss and incidence of PPH

The new technique was implemented in 55 patients with refractory to usual measures and

Table 2. Intraoperative and postoperative parameters

Parameter	Repair group (n=55)	Control group (n=55)	*p*-Value
Intraoperative and Postoperative blood loss in the 1st 24 hours (g), mean (SD)	523.64±253.97	660.00±278.55	0.008*
Surgery time (minute), n (%)	48.24±11.46	47.82±8.88	0.831
Neonatal birth weight (kg), mean (SD)	3322.73±402.22	3405.09±343.62	0.251
5 min Apgar < 7, n (%)	1 (1.82%)	1 (1.82%)	1.00
Macrosomia, n (%)	2 (3.63%)	3 (5.45%)	0.647
Puerperal morbidity, n (%)	5 (9.09%)	7 (12.73%)	0.541
Application of potent tocolytic agent after surgery, n (%)	3 (5.45%)	11 (20.00%)	0.022*
Hospital stay (day), n (%)			0.012*
≤3	48 (87.27%)	37 (67.27%)	
>3	7 (12.73%)	18 (32.73%)	
Hospital stay (day), mean (SD)	3.15±0.62	3.55±0.96	0.011*

*Denotes significant values if $p < 0.05$. Abbreviations: BMI, body mass index; SD, standard deviation. Puerperal morbidity: Illness arising during the first 10 days of the postpartum period, that is, a temperature of 38°C or more on any 2 days of the first 10, excluding the first 24 hours.

it was found to be superior to the classic CS with less blood loss (523.64±253.97 vs 660.00±278.55 g in repair group and control group respectively, p=0.008). 4 patients (7.27%) in the repair group and 7 patients (12.73%) in the control group were diagnosed with PPH, but after application of tocolytic agent, none of them received blood transfusion. There were no incidences of adjacent organ injuries and need for hysterectomy in any patient.

Other complications

The two groups were compared with regards to the complications of the surgery. The duration of surgery ranged from 31 minutes to 79 minutes, longer surgery time was needed in the repair group but the difference between groups has no statistical significance. There was no significant difference between the two groups in other parameters as puerperal morbidity, baby weight or Apgar score. But less patients in the repair group need application of tocolytic agent (p=0.022). Also the lengths of hospital stay were shorter for the repair group (p=0.012). (**Table 2**).

Multivariate analysis

Multivariate binary logistic regression analysis demonstrated no superiority of the repair group in reducing the risk of PPH or application of tocolytic agents after adjustment of the confounding factors (adjusted OR 0.90, 95% CI 0.10, 7.91; adjusted OR 0.26, 95% CI 0.06, 1.07; respectively). But in the repair group, less patients need prolonged hospital stays (>3 days) (adjusted OR 3.96, 95% CI 1.36, 11.56).

Discussion

The main finding of our study is a simple suturing method could reduce the blood loss in ERCS without increasing the risks of injuries to adjacent organs or infections. It was clear that patients in the repair group recovered more quickly with shorter hospital stay than the non-repair group. Less patients from the repair group required the use of tocolytic agents. There was no significant difference in other intraoperative and postoperative parameters like operation time or puerperal morbidity, the difference and advantages might be revealed with a larger sample size.

Pharmacologic and manual interventions should be the first line of treatment for PPH. If pharmacologic treatments proved to be unsuccessful, different surgical methods were applied. B-Lynch pioneered the use of uterine compression sutures, the procedure was simple and effective to compress the uterus without occluding the uterine arteries or uterine cavity [13]. Since then, many suturing methods have been invented which were targeted at the atony of the uterine wall [17-20]. However, only a few methods were reported when the bleeding was from the lower segment of uterus. Our study showed a new and simple yet effective suturing method which could be applied in the lower segment. In a study conducted in Argentina, methods were compared as for bleeding from the cervix or upper vagina, only

the Cho suture (square suture) was successful [21]. However, Cho suture appears to be associated more frequently with complications such as uterine necrosis and uterine synechiae [20, 22]. Considering the "uterine penetration" and "compression tightness" characteristics in Cho suture, the high incidence of complications were predictable. In our study, none of these adverse events were observed in the new sutures during the follow-up time.

The physiological structure of uterine wall was changed after prior CS. Aberrancy in wound healing caused by myofiber disarray and elastosis was noticed in injured myometrium compared with uninvolved myometrium during histopathologic examination following an iatrogenic uterine trauma [23]. Small fibroids and keloid-like structures were found within scars in uterine wound healing, this may lead to ineffective uterine contraction due to the lack of normal muscle fibers [23]. Uterine cervix was supplied by the descendent part of the uterine artery which is not winding like the ascending branch. In the course of pregnancy, the parts of uterus do not grow proportionally. The course and winding of these supply arteries are configured according to this disproportion [24]. These changes could lead to insufficient blood supply to the cervix, which is the lower segment of uterus during pregnancy, especially the scar tissue. Distortion and widening of the lower uterine segment and overhanging of the endometrium above the scar were the possible reasons for bleeding in this part of uterus [25]. Our method of suturing could shrink the wide area of elongated lower segment, close the blood sinus caused by placental separation directly and help to restore the normal physiological structure of uterus. It did not have much influence to the blood supply to the uterus, so its influence towards reproductive function is negligible. This suture was mainly performed on the lower segment of uterus, so the injury to the gastrointestinal tract could be avoided.

Currently, techniques targeted at lower segment suturing described in the literature were mainly for controlling massive bleeding associated with placenta previa, especially in cases with placenta accreta [26-29]. Few methods were reported in scar uterus when the bleeding was caused by the atony of lower segment. El Gelany et al reported a method of suturing the anterior lip of the cervix to the anterior wall of the lower uterine segment if the bleeding originated primarily from this site in repeated CS, they used the cervix as a natural tamponade and stopped bleeding successfully [30]. But the complications encountered were bladder injuries and wound infection. Liu et al included 38 patients diagnosed with pernicious placenta previa in Tongji Hospital, China. Multiposition spiral suture in the lower uterine segment was used when massive bleeding occurred after removing the placenta [31]. Their methods seem more time-consuming and were useful mainly when the bleeding spot was clearly observed. In a study in Thailand in 2008, 32 patients with PPH were managed by lower uterine compression treatment [32]. Their method was simple to use, but in cases of uterine scar dehiscence, the simple compression method might not be appropriate. Bakri balloon and radiological embolization were also the optional methods. But in a country like China, a vast territory with distinguishable differences of regional economic medical resources, lack of these interventions were problems in many primary hospitals. Our time-saving and easy-to-learn suturing method could play a role when the optional measures to stop bleeding is very limited. We timed this procedure in about 10 patients and in each of them this procedure was completed in about 4 minutes after careful separation of the adhesions and stop bleeding. Time to perform the hemostatic technique of Cho suture ranged from 5 minutes to 10 minutes [21]. The average time of in El Gelany's study was 5.4±0.6 minutes, but an assistant was sometimes needed to elevate the cervix [30]. The average time of compressive suture technique together with CS described in an Italian study involving patients with placenta previa was 60.4±14.5 minutes, more time was needed to protect the bowel from incidental puncture [26]. Our method was performed in the anterior side of uterus, the procedures were observed easily and had no blind spot, anatomical level was relatively superficial compared to other methods. It is an easy to learn technique because of these features. However, our suturing method did have its drawbacks. The indication of this method was aimed at bleeding from the lower segment of uterus. The peritoneal reflection was pushed down to make enough exposure for suturing. This procedure poses a considerable risk of injuring the bladder, which

is already with higher risk because of the adhesion in repeated CS [11, 33, 34].

The strengths of this study includes randomization by the inpatient number. The surgeries were performed by two doctors whose surgical techniques were comparable. Patients in our study were intensively observed and clinical interventions were applied immediately. But doctors performing surgeries were not blinded, that could have biased the outcome of this study. We did not record and compare the exact time performing this technique, only the duration of the whole procedure with CS were calculated. Further follow-up of the patients like mearing the scar thickness after surgery were not performed. And the long term complications of this method still need to be explored.

Conclusion

This new repairing surgery is effective in controlling postpartum hemorrhage in repeated CS patients with unsubstantial lower segment of uterus. The hospital stay time was shorter in repair group. With the advent of second child boom coming and increasing social status of Chinese women, Chinese doctors are shouldering heavy responsibilities from the high CS rate. This simple suturing method could be used in basic-level hospitals of China. Long term effect and practical value of this procedure still need to be explored.

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Disclosure of conflict of interest

None.

Abbreviations

CS, caesarean section; ERCS, elective repeat caesarean section; PPH, postpartum hemorrhage; LUS, lower uterine segment; VBAC, vaginal birth after caesarean delivery; SPSS, Statistical package for social science; BMI, Body Mass Index; mm, millimeter; SD, standard deviation.

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