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MATERNAL-FETAL MEDICINE

Single square hemostatic suture for postpartum hemorrhage secondary to uterine atony

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Abstract
Objective The objective of this study is to describe a novel technique for the treatment of postpartum hemorrhage and evaluate its effectiveness and safety.
Methods Single square hemostatic suture was performed for uterine atony when postpartum hemorrhage did not respond to medical therapy and bilateral uterine artery ligation. We retrospectively reviewed the data of 11 women and evaluated their endometrial cavity with hydrosonography after a follow-up period of 8–34 months.
Results The single square hemostatic suture successfully stopped bleeding in all of the cases. Of the 11 women, 2 could not be traced. Menstruation started without delay in nine women. One of the women achieved pregnancy 25 months after surgery. The six women who underwent hydrosonography had an intact endometrial cavity.
Conclusions For women who desire future fertility, and when bilateral uterine artery ligation is not sufficient to control PPH, single square suturing may be used as an effective and safe procedure.

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Introduction

Atony is the most common cause of postpartum hemorrhage (PPH) [1]. Uterine massage, placental removal, uterotonic administration, and uterine balloon tamponade constitute the first-line management options. In case of failure to stop bleeding, uterus-sparing procedures, such as uterine artery ligation, internal iliac artery ligation, and selective uterine artery embolization are performed, with hysterectomy as a last resort. Compression suture is another conservative surgical approach, which is found to be successful in avoiding hysterectomy in 91.7 % of cases [2]. It provides hemostasis by reducing the size of the uterine cavity as with bimanual uterine compression. Similar to uterine devascularization techniques, it is carried out easily and quickly, and it does not require any special surgical skills.

B-Lynch suture is the prototype of compression sutures and has been widely used around the world since it was described in 1997 [3]. In 15 years, different variations of the uterus compression sutures have evolved. Unlike internal iliac artery ligation, these procedures do not have a risk of ureteral or vascular injury, but they are not free of complications. Uterine synechia, myometrial necrosis in fundus and pyometra are reported following various compression suture procedures [4–6]. Furthermore, the data regarding subsequent fertility and obstetric outcome after these procedures are not sufficient. There are only isolated case reports of successful pregnancies after compression sutures either alone or combined with another surgical procedure [7, 8].

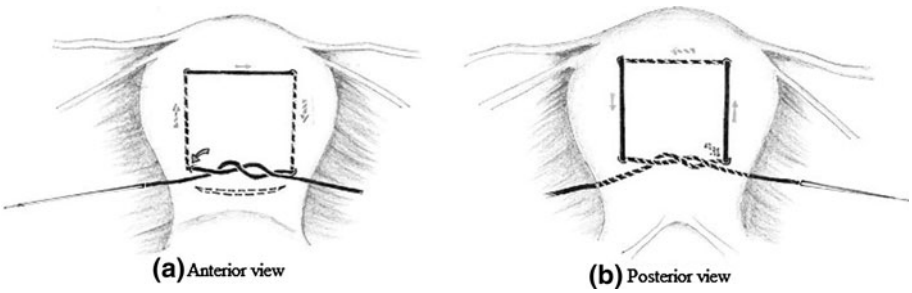

Fig. 1 The suture can be viewed horizontally on the anterior and vertically on the posterior aspect of the uterus. Finally, it is tied on the anterior wall as tightly as possible

In this paper, we describe a novel technique for the treatment of PPH secondary to uterine atony, the single square hemostatic suture, and evaluated its effectiveness and safety.

Materials and methods

In this institutional review board approved study, we retrospectively reviewed the data of 11 consecutive patients with PPH who underwent the single square suture in our clinic between June 2008 and August 2010. The cause of PPH was uterine atony in all cases. The protocol for management of atony in our institution included the administration of 20 U oxytocin in 1,000 ml lactated ringer intravenously at approximately 10 ml/min, 0.2 mg intramuscular methylergonovine, 400 μg rectal misoprostol, and bimanual uterine massage. If these were insufficient to control bleeding, the patient was transferred to the operating theatre. The first-line surgical procedure in our clinic was bilateral uterine artery ligation, which was placed around the ascending uterine artery and accompanying veins at a level just below the site of the low-transverse uterine incision. If the bleeding did not respond to it, we decided to perform square suture procedure immediately. All patients gave informed consent after being told the risks of the surgery.

In this technique, which is demonstrated in Fig. 1, the uterus is exteriorised. The needle is firstly inserted about 3 cm above the uterine incision and approximately 4 cm from the right lateral border, and passed from the anterior to the posterior aspect through the uterine walls. Then we insert the needle behind the uterus at about 4 cm below fundus and almost 4 cm from right lateral border from the posterior to the anterior aspect. The needle is passed through the corresponding points on the left side of the uterus, but at opposite direction, passing from anterior to posterior below the fundus and from posterior to anterior at the lower segment. The suture is then tied effectively at the anterior side and the fundus becomes hyperflexed lying over the isthmic region. In case of vaginal delivery, there is no need to open a lower segment incision, and the insertion points are determined according to an imaginary Kerr incision. However, if a Kerr incision has already been opened, it is closed after square hemostatic suturing, when the bleeding is controlled completely. For all our cases, we used Polygalactin 910 (coated Vicry-Ethicon) No. 1 on a 48 mm ½ circle tapered needle. As we could not find a suture with a bigger needle in the operation room, we straightened the curved needle and made it straight with the help of a needle holder.

The patient's age, parity, gestational age at which the surgery was performed, the mode of delivery and concomitant conditions were recorded. Estimated blood loss, the amount of transfused blood products, postoperative follow-up, and duration of hospital stay were noted. The patients were reexamined at sixth week postpartum. All of the patients who underwent square hemostatic suture were invited to the hospital and asked the presence of any late postoperative complications and subsequent pregnancies, as well as their menstrual history. We performed hydrosonography in order to evaluate the endometrial cavity.

Results

Table 1 shows the characteristics of patients. The patients were aged between 17 and 33 (mean 26). Parity ranged from 1 to 5 and the gestational age at which the procedure was performed, ranged from 34 to 39 (mean 37.5). The weight of babies ranged between 1,810 and 3,260 g (mean 2,670 g). Two of the cases were intrauterine fetal demise because of placental abruption. Only one of the PPH cases occurred after the vaginal delivery, and due to the intractable massive PPH, the patient was transferred to the operating theatre 2 h after the delivery. Out of 11 cases, in one case PPH occurred after elective cesarean section, which was performed because of breech presentation. Bleeding started 4 h after the operation, and when the bleeding did not respond to medical treatment, a decision for surgery was made. In the other nine cases, PPH developed during cesarean section. The indications were dystocia in one case, placental abruption in six cases, twin pregnancy with breech presentation in one case, and previous cesarean section in one case. Estimated blood loss was 600–3,200 ml (mean 1,260 ml). Eight cases underwent

Table 1 Summary of patient characteristics and clinical outcomes

Case	Age (years)	Gestational weeks	Parity	Mode of delivery	Concomitant condition	EBL (ml)	Transfusion	Follow-up (months)	Outcome
1	24	34	G2P1	Emergency C/S	Placental abruption	1,200	3 U PCT 2 U FFP 4 g fibrinogen	32	Pregnant (28 weeks)
2	31	39	G2P1	Elective C/S	Previous C/S	600	–	34	Not known
3	28	37	G2P1	Emergency C/S	Placental abruption, preeclampsia	2,400	4 U PCT 4 U FFP 4 g fibrinogen	33	Not known
4	33	37	G4P3	Emergency C/S	Placental abruption	1,200	6 U PCT 2 U FFP	29	Normal menstruation Normal hydrosongraphy
5	32	37	G5P3	Emergency C/S	Twin, preecalampsia	600	–	16	Normal menstruation Normal hydrosonography
6	17	39	G1P0	Emergency C/S	Dystocia	1000	–	20	Normal menstruation Normal hydrosonography
7	25	38	G6P5	Emergency C/S	Placental abruption	3,200	4 U PCT 4 U FFP 2 unit platelet 4 g fibrinogen	18	Normal menstruation Normal hydrosonography
8	21	39	G1P0	Vaginal delivery	–	1,500	2 U PCT 5 U FFP 4 g fibrinogen	10	Normal menstruation Normal hydrosonography
9	23	36	G2P1	Emergency C/S	Placental abruption	800	2 U PCT 2 U FFS 4 g fibrinogen	10	Normal menstruation Normal hydrosonography
10	29	39	G2P1	Emergency C/S	Placental abruption Relaparoto	800	2 U PCT	8	Normal menstruation
11	26	38	G1P0	Elective C/S	MyBreech presentation	600	2 U PCT	8	Normal menstruation

C/S cesarean section, *PCT* packed cell transfusion, *FFP* fresh-frozen plasma, *EBL* estimated blood loss

intra or postoperative blood transfusion. The uterotonic drugs were ineffective and bilateral uterine artery ligation was not sufficient to control bleeding. In all cases, bleeding ceased after the compression suture and hysterectomy was avoided. Bilateral tubal ligation was performed on two women according to their wish. In all cases, the pelvis and abdomen were closed after inserting a drain into the pelvis. No women had delayed hemorrhage. Cefazolin 4.5 g was administered intravenously as antibiotic prophylaxis during the first postoperative day. There were no postoperative complications and the hospital stay ranged from 2 to 7 days (mean 3.7). All patients were examined 6 weeks after hospital discharge.

After a duration of 8–34 months (mean 20 months), patients were invited to the hospital. Two of the patients could not be reached by telephone. Another two could not come to hospital as they had moved to another city, but we gained data of their menstruation by telephone interview. All of the nine patients that we could reach had normal regular menstrual cycles. None of the patients had experienced any complications regarding the surgery. One of the patients achieved pregnancy 25 months after surgery. We performed hydrosonography on six women. The endometrial cavity was regular and there were no adhesions.

Discussion

We devised a new compression suture technique and tested it on 11 atony cases, which failed to respond to uterotonic drugs and bilateral uterine artery ligation. Our technique yielded very good results as bleeding ceased and hysterectomy was avoided in all cases. None of the patients experienced complications and those who underwent hydrosonography had regular endometrial cavity with no adhesions.

Since we used bilateral uterine artery ligation as the first-line surgical treatment, and save compression sutures for the intractable cases, we tested this technique not on all

Table 2 The variations of uterine compression sutures

Author	Technique
B-Lynch et al. [3]	Involves lower uterine incision, suture loops the fundus twice without transfixing the anterior and posterior walls
Pereira et al. [15], Zheng et al. [16]	Avoid suturing anteroposterior diameter of the uterine cavity
Hayman et al. [17], Bhal et al. [18]	Separate vertical sutures and passing the anteroposterior diameter of uterus at cervico-isthmic regions
Marasinghe and Condous [19]	Two separate vertical sutures and passing the anteroposterior diameter of uterus at cervico-isthmic and fundal regions
Cho et al. [20]	Multiple full thickness square sutures placed at the selected areas of heavy bleeding to compress anterior and posterior uterine walls
Hackethal et al. [21]	6–16 horizontal interrupted sutures starting at the fundus and ending at the cervix
Ouahba et al. [22]	Four sutures; two transverse in the middle of uterine body and in the lower segment, and two near the horns
Matsubara et al. [23]	Three longitudinal and two transverse sutures, used also to prevent recurrence of uterine inversion
Nelson and O'Brien [24]	Concomitant use of intrauterine Bakri balloon and B-Lynch suture

atony cases, but on whom bilateral uterine ligation was not successful to stop bleeding. The rationale of performing compression suture as a second-line procedure was the lack of studies that assessed fertility after compression sutures adequately. Sentilhes et al. [9, 10] suggested that bilateral uterine artery ligation, which was previously shown to preserve the patients' subsequent fertility should be the first-line uterus-sparing procedure. We also opted for bilateral uterine artery ligation as the first option because it is a successful, safe, and simple procedure. O'Leary published a report of 265 cases of postpartum hemorrhage treated by bilateral ligation of uterine artery with 95 % success rate and reported complications were only two cases of broad ligament hematoma [11]. The other option, internal iliac artery ligation is technically difficult and includes the risk of several serious complications such as vein laceration, ureter injury, and inadvertent ligation of the arterial blood supply to the lower limb. These disadvantages led us to favor compression suture over internal iliac artery ligation.

There are many different variations of uterus compression sutures, which are indicated in Table 2. Although, our technique has some resemblance with Cho's technique, it is different in many aspects. Firstly, the suture passing the uterine cavity anteroposteriorly is only 4 cm away from the uterus borders, and the centre of uterine cavity is intact, because of which there was no synechia in our cases. In addition, we pierce the uterus only four times, so it does not create a big risk for necrosis, infection, or uterine wall bleeding. In Cho's technique, multiple sutures going through the uterine cavity anteroposteriorly may interfere with physiologic involution and may result in blood-filled pockets inside the uterine cavity [12]. Reyftmann et al. [13] reported partial uterine wall necrosis following four Cho hemostatic sutures, which was confirmed by the biopsy of heterogenous whitish area at the fundus. Wu and Yeh [5] reported a case of uterine synechiae with partial obstruction of menstrual flow. Moreover, this technique has been reported to be associated with pyometra and subsequent hysterectomy [6]. As there are no multiple small squares in our technique, the risk of blood trapping is lower, and the drainage of the endometrial cavity remains normal without the formation of a hematometra.

In addition, there are some advantages of our technique over B-Lynch suture. Akoury and Sherman [14] reported a large triangular myometrial defect in the mid-anterior uterine wall and two smaller defects in the posterior wall during the subsequent pregnancy following the surgery in which one B-Lynch plus two Cho sutures had been placed for PPH. Similarly Humara et al. [4] reported a full-thickness muscular defect at the fundus measuring 30 × 40 mm during the subsequent pregnancy following B-Lynch suturing. Placement of too tight aberrant B-Lynch compression sutures with the occlusion of blood flow to the fundal region causes necrosis of myometrium, which is replaced by fibrosis. The fibrous band weakens because of the enlargement of gravid uterus, which results in myometrial defect during the latter half of a subsequent pregnancy [4]. In our technique, the suture does not pass over the fundus and the blood flow through utero-ovarian arteries is not occluded. Therefore, there is no risk of fundal necrosis in our technique. Additionally, after the involution of uterus there is no loosened suture over the fundus; thus, there is a low risk of bowel entrapment, which results in ileus.

The main limitation of this study is its small sample size. Although we found that this technique does not impair fertility, more studies with a longer period of follow-up and larger samples are required to confirm the potential advantages of this procedure. Nevertheless, our results are encouraging, since the hydrosonography of six patients revealed normal endometrial cavity and one patient achieved a successful pregnancy.

We conclude that our technique is easy, quick and without any serious complications. For women who desire future fertility, and when bilateral uterine artery ligation is not sufficient to control PPH, single square suturing may be used as an effective and safe procedure.

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Conflict of interest None.

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