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# Single, double, and triple modalities of uterine-sparing treatment for primary postpartum haemorrhage: a 14-year retrospective cohort study

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***Introduction:*** To evaluate the success rate and short-term complications of single, double, and triple modalities of uterine-sparing treatment (UST) for primary postpartum haemorrhage (PPH).
***Methods:*** We retrospectively reviewed records of women who underwent UST for PPH between 2006 and 2019 in Tuen Mun Hospital. The success rates of single, double, and triple modalities of UST (derived from the number of haemostatic hysterectomies prevented) were compared, as were short-term complications between single and double modality groups.
***Results:*** Of 221 women who underwent UST for primary PPH, 174 (78.7%) received single, 44 (19.9%) received double, and 3 (1.4%) received triple modalities of UST. The three groups were comparable, except that there were more nulliparous women in the double than single modality group, more women having caesarean sections in the single than double or triple modality group, and more uterine atony in the double or triple than single modality group. The success rate of haemostasis decreased from 94.3% after single modality to 90.9% after double modalities to 0% after triple modalities ($p<0.001$). All three women with triple modalities of UST eventually underwent haemostatic hysterectomy. The single and double modality groups were comparable in terms of short-term complications.
***Conclusion:*** Single and double modalities of UST were effective and safe in treating primary PPH. Early resort to hysterectomy should be considered if double modalities of UST failed to achieve haemostasis.

*Keywords: Hemostasis; Hysterectomy; Postpartum hemorrhage; Uterine haemorrhage*

## Introduction

Postpartum haemorrhage (PPH) is an important cause of maternal morbidity and mortality. It occurs in 5% of the deliveries and is classified as severe in 1% of cases[1,2]. Primary PPH is defined as genital tract bleeding of ≥500 mL within 24 hours of birth. When uterotonic drugs fail to stop haemorrhage, uterine-sparing treatments (UST) such as intrauterine balloon tamponade, uterine compression suture, pelvic artery ligation, and pelvic artery embolisation are indicated. None of the modalities is superior to the others[3]. There are no adverse effects of UST on menstruation and fertility outcomes[4]. When haemostasis is not achieved after a single modality of UST, use of the second modality is suggested[5]. Nevertheless, there is no evidence regarding the efficacy and potential complications of multiple UST. Devascularisation of the uterus can result in ischaemic events to the endometrium-myometrium interface. Uterine necrosis has been reported after uterine compression suture[6-8], pelvic artery embolisation[9], or a combination of compression suture and vascular ligation[10], with fever and abdominal pain on the third day postpartum. Computed tomography shows the presence of gas bubbles in the myometrium. The present study aimed to determine the success rate of single, double, and triple modalities of UST in achieving haemostasis, and to compare the incidence of short-term complications between single and double modalities.

## Methods

This retrospective study was approved by the New Territories West Cluster Ethics Committee (reference: NTWC/CREC/15039). Women who underwent UST in Tuen Mun Hospital from April 2006 to February 2019 were followed up at 6 weeks postpartum. Demographic, antenatal, and intrapartum data were retrieved. The success rate of single and multiple modalities of UST was derived from the number of hysterectomies prevented.

The surgical techniques and suture materials were standardised. Uterine compression suture (including B-Lynch suture and Hayman suture) were performed with No. 1 Monocryl. Cho suture and uterine artery

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ligation (UAL) were performed with No. 1 Vicryl. Uterine artery embolisation was performed by radiologists in operating rooms or radiology suites. Bakri balloons (Bakri Postpartum Balloon, Cook Medical) were the preferred UST in women with uterine atony after vaginal deliveries. Sequence of UST was decided by the treating physician case by case. Failure of a modality was defined clinically by ongoing bleeding after 15 minutes. To minimise the risk of maternal sepsis, one week of empirical antibiotics (750 mg intravenous cefuroxime and 500 mg intravenous metronidazole) was prescribed.

Short-term complications of UST (within 6 weeks postpartum) were recorded, including secondary PPH (abnormal genital tract bleeding between 24 hours and up to 12 weeks postnatally[11]), endometritis, puerperal sepsis (infection plus systemic manifestations developing after birth until 6 weeks postnatally[12]), pyometra, haematometra, uterine necrosis, and vessel complications (thrombosis, dissection, aneurysm, and pseudoaneurysm).

The amount of lochia, presence of abdominal pain, abnormal vaginal discharge or fever were recorded at postnatal 6 weeks. A routine gynaecological examination was performed. Genital swabs and blood tests were taken if infection was suspected. Ultrasonography of the pelvis was performed if there was abnormal vaginal bleeding. Women who lost to follow-up were contacted by phone, and appointments were offered for symptomatic cases.

Statistical analysis was performed using SPSS (Windows version 21; IBM Corp, Armonk [NY], US). Women in the three groups of modalities of UST were compared using the one-way ANOVA, Fisher's exact test, or Chi-squared test. Short-term complications between single and double modalities of UST were compared using the Chi-squared test or Fisher's exact test. A p value of $<0.05$ was considered statistically significant.

## Results

Of 72 596 deliveries in our unit in the past 14 years, 221 (0.3%) women underwent UST for primary PPH. Among them, 174 (78.7%) received single, 44 (19.9%) received double, and 3 (1.4%) received triple modalities of UST. Eight (3.6%) women had a history of PPH. The amount of blood loss ranged from 500 mL to 12 000 mL (median, 2400 mL). The commonest cause of PPH was uterine atony (42.5%). Regarding the mode of delivery, 198 (89.6%) women had caesarean sections, 20 (9.0%) had normal vaginal deliveries, and 3 (1.4%) had vacuum extractions. Women who underwent UST were comparable in terms of maternal, antepartum, and intrapartum characteristics, except that there were more nulliparous women in the double than single modality group, more women having caesarean sections in the single than double or triple modality group, and more uterine atony in the double or triple than single modality group (Table 1). The median blood loss increased from 2000 mL after single modality to 4800 mL after triple modalities, whereas the use of recombinant factor VIIa and blood products transfusion increased with the number of modalities performed (Table 1).

Of 174 women with single modality of UST, 162 (93.1%) delivered by caesarean sections, 9 (5.2%) vaginally, and 3 (1.7%) by vacuum extractions. UAL was most commonly performed (n=110, 63.2%), followed by compression suture (n=38, 21.8%) [Table 2]. Single modality of UST successfully achieved haemostasis in 164 (94.3%) women. The remaining 10 (5.8%) women failed to achieve haemostasis and necessitated hysterectomy despite having had UAL (n=5), uterine artery embolisation (n=3), or compression suture (n=2); the causes of PPH were uterine atony (n=6), morbid adherence of the placenta (n=2), placenta praevia (n=1), and vaginal haematoma extending into the broad ligament (n=1).

Of 44 women with double modality of UST, 34 (77.3%) delivered by caesarean sections and 10 (22.7%) vaginally. A combination of UAL and compression suture was most commonly performed (n=30, 68.2%) [Table 2]. Double modality of UST successfully achieved haemostasis in 40 (90.0%) women. The remaining 4 (9.1%) women failed to achieve haemostasis and necessitated hysterectomy despite having had UAL plus compression suture (n=3) or compression suture plus uterine artery embolisation (n=1); the causes of PPH were uterine atony (n=3) and placenta praevia (n=1).

In the three women with triple modality of UST for uterine atony, one underwent Bakri ballooning and then laparotomy for UAL and then compression suture, and two underwent Hayman's suture and then UAL and then traditional B-Lynch suture (Table 2). However, all these women failed to achieve haemostasis and necessitated hysterectomy.

The success rate of haemostasis decreased from 94.3% after single modality to 90.9% after double modalities to 0% after triple modalities ($p<0.001$, Table 2). The single and double modality groups were comparable in terms of short-term complications such as secondary PPH (4.0% vs

**Table 1. Maternal, antepartum, and intrapartum characteristics of women who underwent single, double, or triple modalities of uterine-sparing treatment**

| Characteristic | Single modality (n=174)* | Double modalities (n=44)* | Triple modalities (n=3)* | p Value |
|---|---|---|---|---|
| Age, y | 34 (31.0-37.0) | 32.5 (28.3-35.0) | 31 | 0.08 |
| Chinese | 169 (97.1) | 43 (97.7) | 3 (100) | >0.99 |
| Body mass index, kg/m$^2$ | 22.1 (20.6-24.7) | 21.8 (20.4-24.8) | 27.3 | 0.090 |
| Nulliparity | 71 (40.8) | 28 (63.6) | 1 (33.3) | 0.014 |
| Natural conception | 144 (82.8) | 34 (77.3) | 3 (100) | 0.666 |
| Multiple pregnancy | 23 (13.2) | 6 (13.6) | 0 (0) | >0.99 |
| Previous caesarean section | 48 (27.6) | 8 (18.2) | 2 (66.7) | 0.124 |
| History of postpartum haemorrhage | 7 (4) | 1 (2.3) | 0 (0) | >0.99 |
| Polyhydramnios | 3 (1.7) | 3 (6.8) | 0 (0) | 0.170 |
| Fibroid ≥3 cm | 9 (5.2) | 3 (6.8) | 0 (0) | 0.756 |
| History of antepartum haemorrhage | 56 (32.2) | 7 (15.9) | 0 (0) | 0.058 |
| Gestation at delivery, weeks | 39 (1) | 38.5 (3) | 38 | 0.10 |
| Mode of delivery | | | | 0.004 |
| Vaginal/instrumental delivery | 12 (6.9) | 10 (22.7) | 1 (33.3) | |
| Caesarean section | 162 (93.1) | 34 (77.3) | 2 (66.7) | |
| Intrapartum fever (≥38.5°C) | 4 (2.3) | 0 (0) | 0 (0) | 0.607 |
| Induction of labour | 26 (14.9) | 13 (29.5) | 0 (0) | 0.066 |
| Use of tranexamic acid | 53 (30.5) | 21 (47.7) | 1 (33.3) | 0.085 |
| Use of recombinant factor VIIa | 4 (2.3) | 7 (15.9) | 1 (33.3) | 0.001 |
| Blood products transfused, units | | | | |
| No. of red blood cell | 2 (3) | 8 (6) | 8 | <0.001 |
| No. of platelet | 0 (18) | 8 (5) | 8 | <0.001 |
| No. of fresh frozen plasma | 0 (4) | 8 (7) | 8 | <0.001 |
| Blood loss, mL | 2000 (1300-3000) | 3550 (2500-4875) | 4800 | <0.001 |
| Birthweight, kg | 2.92 (2.49-3.22) | 2.85 (2.44-3.55) | 3.30 | 0.630 |
| Primary cause of postpartum haemorrhage | | | | 0.008 |
| Uterine atony | 76 (43.7) | 30 (68.2) | 3 (100) | |
| Placenta praevia/ morbidly adherent placenta | 92 (52.9) | 11 (25) | 0 (0) | |
| Genital tract trauma | 5 (2.9) | 1 (2.3) | 0 (0) | |
| Coagulopathy | 1 (0.5) | 2 (4.5) | 0 (0) | |

* Data are presented as median (interquartile range) or No. (%) of women

9.1%), endometritis (1.7% vs 6.0%), haematometra (0% vs 2.3%), and vessel complications namely iliac artery dissection (0% vs 2.3%) [Table 3]. No patients developed pyometra, uterine necrosis, or ureteric injury.

## Discussion

Uterine atony is the commonest cause of PPH[13]. In the present study, most women who underwent two modalities of UST were nulliparous, as obstetricians tried to preserve the uterus in these women. The success rate of haemostasis by single and double modalities of UST was 94.3% and 90.0%, respectively, which are higher than the 84% to 91.7% after single modality of UST reported in a systematic review[3]. The combined use of B-Lynch suture and stepwise pelvic artery devascularisation prevented 80% of haemostatic hysterectomy[14]. However, the success rate dropped to 0% after triple modalities. UAL was the first UST performed in our centre and has been preferred

**Table 2. Types of uterine-sparing treatment in the single, double, and triple modality groups**

| Modality | No. (%) of women | No. (%) of women avoided hysterectomy |
|---|---|---|
| Single modality | 174 (78.7) | 164 (94.3) |
| Uterine artery ligation | 110 (63.2) | 105 |
| Compression suture | 38 (21.8) | 36 |
| B-Lynch suture | 14 (8.0) | - |
| Hayman's suture | 24 (13.8) | - |
| Balloon tamponade | 12 (6.9) | 12 |
| Uterine artery embolisation | 14 (8.0) | 11 |
| Double modalities | 44 (19.9) | 40 (90.9) |
| Uterine artery ligation + compression suture | 30 (68.2) | 27 |
| Uterine artery ligation + Cho's suture | 2 (4.5) | - |
| Uterine artery ligation + B-Lynch suture | 10 (22.7) | - |
| Uterine artery ligation + Hayman's suture | 18 (40.9) | - |
| Balloon tamponade + uterine artery embolisation | 10 (22.7) | 10 |
| Uterine artery ligation + uterine artery embolisation | 2 (4.5) | 2 |
| B-Lynch suture + uterine artery embolisation | 1 (2.3) | 0 |
| Hayman's + B-Lynch suture | 1 (2.3) | 1 |
| Triple modalities | 3 (1.4) | 0 (0) |
| Uterine artery ligation + Hayman's suture + B-lynch suture | 2 (66.7) | 0 |
| Balloon tamponade + uterine artery ligation + Hayman's suture | 1 (33.3) | 0 |

**Table 3. Short-term complications in single and double modality groups**

| Complication | Single modality (n=174)* | Double modalities (n=44)* | p Value |
|---|---|---|---|
| Secondary postpartum haemorrhage | 7 (4.0) | 4 (9.1) | 0.236 |
| Endometritis | 3 (1.7) | 3 (6.8) | 0.098 |
| Puerperal sepsis | 13 (7.5) | 2 (4.5) | 0.741 |
| Pyometra | 0 (0) | 0 (0) | >0.99 |
| Haematometra | 0 (0) | 1 (2.3) | 0.202 |
| Uterine necrosis | 0 (0) | 0 (0) | >0.99 |
| Vessel complications | 0 (0) | 1 (2.3) | 0.202 |

* Data are presented as No. (%) of cases

by our obstetricians since 2007. Two women with triple modalities underwent B-Lynch suture after Hayman's suture failed, with the old suture completely removed.

There is no consensus on the sequence of modalities of UST to achieve haemostasis. The use of double modalities is supported because the success rate is comparable to that with single modality, with no increase in complication rates. One study reported that 14 (93.3%) of 15 women had uneventful recovery after double modalities of UST, and the remaining woman had pyometra[14]. In addition, safety, fertility, and obstetric outcomes are reassuring following the combined use of embolisation and B-Lynch suture[15]. However, the use of triple modalities is a factor of poor prognosis; other factors include a delay in deciding on UST, a lack of decisional clinical algorithm, hypovolaemic shock, and the irregular supply of blood products[16]. We recommend that haemostatic hysterectomy should be

resorted to after failing two modalities to avoid further blood loss and delay of performing hysterectomy resulting in disseminated intravascular coagulopathy, which makes haemostasis more difficult.

Our study is limited by the differences in the number of women who underwent different modalities of UST. Furthermore, other factors affecting the success rate of UST were not assessed, including the time interval from the diagnosis of PPH to the initiation of UST, the availability of skilled surgeons, and the rate of correction of disseminated intravascular coagulopathy. The optimal treatment option could not be inferred. Uterine curettage was reported to successfully drain the haematometra after the use of UAL, B-lynch suture, or square suture at 4 months postpartum without recurrences[17]. In the only patient with haematometra who presented with persistent spotting and pelvic pain at 6 weeks postpartum, the haematometra was completely drained under antibiotics cover by the uterine aspirator without anaesthesia. The long-term menstrual and fertility outcomes warrant further studies.

## Conclusion

Single and double modalities of UST were effective and safe in treating primary PPH. Early resort to hysterectomy should be considered if double modalities of UST failed to achieve haemostasis.

## Conflicts of interest

The authors have no conflicts of interest to disclose.

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