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ORIGINAL ARTICLE

Perioperative hemorrhagic complications in pelvic floor reconstructive surgery

Wenjin Cheng[1,2] · Chunyan Bu[1] · Fanling Hong[1] · Xiaozhu Zhong[1,2] · Chengyue Jin[3] · Xin Yang[1,2] · Xiuli Sun[1,2] · Jianliu Wang[1,2]

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Abstract

Introduction and hypothesis We sought to assess the incidence, symptoms, and risk factors of perioperative hemorrhagic complications in patients undergoing pelvic floor reconstructive surgery.

Methods This is a retrospective study on 694 consecutive patients who underwent pelvic floor reconstructive surgery with or without using mesh in our hospital over a 3-year period.

Results We identified 694 pelvic floor reconstructive procedures from 2014 to 2016, including complete/incomplete colpocleisis (176, 25.4%), sacral colpopexy/hysteropexy with mesh (140, 20.1%), colporrhaphy (77, 11.1%) or vaginal mesh repair (99, 43.1%). Two patients who received only sacrospinous ligament suspension were excluded. There were 68 (9.8%) and 3 (0.1%) patients whose blood loss reached 200 and 500 ml respectively. Procedures involving mesh and vaginal hysterectomy (VH) caused more intraoperative blood loss. Postoperative hemoglobin drop was least in colpocleisis ($p < 0.05$). All 6 of the patients (0.9%) who developed postoperative pelvic hematoma underwent concomitant VH, and 5 of them received mesh.

Conclusions Hemorrhagic complications during or after pelvic floor reconstructive surgery are rare. Mesh use and concomitant VH are two major surgical risk factors for hemorrhagic complications in pelvic floor reconstructive surgery.

Keywords Pelvic floor reconstruction · Vaginal hysterectomy · Mesh · Complications · Hematoma · Blood loss

Introduction

The risk of a woman undergoing surgery for pelvic organ prolapse (POP) is 11% [1]. Common complications of pelvic floor reconstructive surgery include bladder or rectal injury, and de novo urinary incontinence. New techniques are being developed to reduce recurrence and surgical complications. The synthetic mesh could give better postoperative pelvic floor support, but it could lead to complications such as mesh exposure and mesh erosion [2].

Hematoma is a major bleeding complication of pelvic surgery. Common symptoms and signs of pelvic hematoma include abdominal pain or bloating, fever, unstable vital signs and difficulty in defecating when the hematoma is large enough. Examinations could show abnormally decreasing hemoglobin inconsistent with blood loss during surgery. The management of hematoma includes prophylactic antibiotic use, conservative treatment, ultrasound-guided drainage of the hematoma, pelvic artery embolization, and hysterectomy. Other hemorrhagic situations discussed in this article include blood loss during surgery, postoperative hemoglobin drop, and transfusion.

To our knowledge, bleeding complications of pelvic floor reconstructive surgery and its association with different surgical approaches have not been described in detail. In this study, we investigated the incidence and risk factors of hemorrhagic complications during and after pelvic floor reconstruction.

✉ Xiuli Sun
sunxiuli918@126.com

[1] Department of Obstetrics and Gynecology, Peking University People's Hospital, Peking University, Beijing, China

[2] Beijing Key Laboratory of Female Pelvic Floor Disorders, Beijing, China

[3] Department of Urology, Peking University People's Hospital, Peking University, Beijing, China

Materials and methods

This is a retrospective study of perioperative hemorrhagic complications of 694 patients who underwent pelvic floor reconstructive surgeries in 2014–2016 at Peking University People's Hospital. Inclusion criteria for the study were patients who underwent colpocleisis, colpopexy/hysteropexy with mesh, colporrhaphy, vaginal repair using mesh and sacrospinous ligament suspension. There were two patients who received only sacrospinous ligament suspension, and were excluded from our study. Colpocleisis was performed in patients who did not desire to preserve their coital function or who could not sustain other pelvic reconstructive surgeries because of their advanced age or comorbidities. Complete colpocleisis was conducted with transvaginal hysterectomy whereas incomplete colpocleisis was performed in patients who kept their uterus. Indication of hysterectomy in our institute, including preoperative pathological findings of the uterus or cervix, including fibroids, adenomyosis, and cervical dysplasia. Laparoscopic surgery was only carried out in patients who underwent colpopexy or hysteropexy, the rest of procedures were conducted transvaginally. Polypropylene mesh Bard Alyte Y-mesh Graft Y100 was used in colpopexy and hysteropexy. In anterior or posterior wall repair, implants used included Bard Avaulta Anterior/Posterior Synthetic Support System, AMS Perigee System with IntePro® Lite™, and porcine small intestine submucosa mesh (SIS; Cook Medical). The first two types of mesh are both transvaginal polypropylene. Only 12 patients received absorbable mesh (SIS). Ethical approval was granted by the Ethics Committee of Peking University People's Hospital.

Preoperative evaluation included pelvic organ prolapse quantification (POPQ), urodynamic studies, and pelvic ultrasound. Complete blood count (CBC) and coagulation studies were performed preoperatively in all patients. Drugs that could affect platelet function, such as aspirin, were discontinued 1 week before surgery. Concomitant TVT was performed when indicated. Complete blood count (CBC) and pelvic ultrasound were performed on the third day after surgery. If there was increased bleeding during surgery, suspected internal bleeding or anemia, complete blood count was tested immediately or on the first day after surgery. If transfusion was required, complete blood count was performed beforehand. Blood transfusion is indicated for any patient with hemoglobin below 70 g/L. Patients whose blood loss reached 500 ml with unstable vital signs or preoperative anemia also received blood transfusion before their CBC result came out.

Perioperative hemorrhagic complications in our study include any bleeding disorders occurring during surgery or within 4 weeks postoperatively.

We analyzed blood loss during surgery, hemoglobin drop postoperatively and red blood cell (RBC) loss before blood transfusion based on hematocrit level. Intraoperative blood loss was calculated by measuring the volume of blood collected by suction and the number of blood gauzes used during surgery. Hemoglobin drop and RBC loss calculated by hematocrit level as shown below could be influenced by the hydration state of patients.

Loss of RBCs was calculated using formulas described by Rosencher et al. [3, 4] as follows:

$$\begin{aligned}&\text{Total RBC loss (ml)}\\&= [\text{pre-op RBC} - \text{post-op RBC}]\\&= \text{Estimated blood volume (ml)}\\&\times [\text{pre-op Hct level}(\%) - \text{post-op Hct level}(\%)]\end{aligned}$$

$$\begin{aligned}\text{Estimated blood volume (ml)} &= \left[\text{Body surface area } \left(\text{m}^2\right)\right] \times 2430\\ \text{Body surface area } \left(\text{m}^2\right) &= 0.0235\,[\text{height (cm)}]^{0.42246}\\ &\quad \times [\text{weight (kg)}]^{0.51456}\end{aligned}$$

The hematoma was diagnosed by ultrasound, which was characterized by a newly found echo-free or hypo-echogenic, nonhomogeneous structure in the pelvic cavity. We calculated the volume of hematoma using formula D1 × D2 × D3 × 0.6. D1, D2, and D3 were orthogonal diameters.

Absolute numbers, percentages, and 95% confidence intervals are reported. Independent-sample t test and one-way ANOVA were used to compare hemorrhagic complications of different procedures using SPSS 22.0. A P value < 0.05 was considered significant.

Results

In total, 46 patients received sacrospinous ligament suspension. Most of the patients ($n = 44$) who underwent sacrospinous ligament fixation received anterior or posterior wall repair with or without using mesh ($n = 376$) concomitantly. The two who received sacrospinous ligament suspension only were excluded for not meeting statistical requirements. One hundred and seventy-six (25.4%) patients underwent colpocleisis with or without concomitant hysterectomy. Colpopexy/hysteropexy using mesh, colporrhaphy, and vaginal mesh repair included 140 (20.1%), 77 (11.1%), and 299 (43.1%) patients respectively. Their ages ranged from 28 to 90 with an average of 65 ± 10. Patients who received colpocleisis were significantly older than other patients ($l < 0.001$) with a higher rate of comorbidities. Their characteristics are shown in Table 1.

Details of bleeding complications in pelvic floor reconstructive procedures are shown in Table 2. Average blood loss in pelvic floor reconstructive surgery was 73 ± 74 ml. There were 68 (9.8%) and 3 (0.1%) patients whose blood loss reached 200 and 500 ml respectively. They were given antibiotics and hemostatics. Blood loss in surgery using

Table 1 Demographic information

	Colpocleisis ($n = 176$)	Colpopexy/ hysteropexy with mesh ($n = 140$)	Colporrhaphy ($n = 77$)	Vaginal mesh repair ($n = 299$)	Total ($n = 692$)
Age ± SD	76 ± 6	55 ± 9	63 ± 11	65 ± 7	65 ± 10
BMI (kg/m^2) ± SD	24.4 ± 3.6	24.6 ± 2.6	24.1 ± 4.1	25.1 ± 3	24.6 ± 3.4
Hypertension, *n* (%)	105 (60.0)	40 (28.6)	39 (50.6)	153 (51.2)	337 (48.6)
Diabetes, *n* (%)	53 (30.1)	14 (10.0)	12 (15.6)	63 (21.1)	143 (20.6)
CHD, *n* (%)	20 (11.4)	3 (2.1)	6 (7.8)	21 (7.0)	50 (7.2)
CVD, *n* (%)	11 (6.3)	1 (0.7)	1 (1.3)	12 (4.0)	25 (3.6)
COPD, *n* (%)	3 (1.7)	0	0	2 (0.7)	5 (0.7)
Hematological disease, *n* (%)	0	1 (0.7)	0	5 (1.7)	6 (0.9)
Preoperative anemia, *n* (%)	3 (1.7)	7 (5.0)	1 (1.3)	6 (2.0)	18 (2.6)
DVT, *n* (%)	2 (1.1)	0	0	1 (3.3)	3 (0.4)
Malignancy, *n* (%)	11 (6.3)	3 (2.1)	4 (5.2)	10 (3.3)	28 (4.0)
Abdominal or pelvic operative history, *n* (%)	18 (10.2)	15 (10.7)	9 (11.7)	34 (11.4)	76 (11.0)

SD standard deviation, *CHD* coronary heart disease, *CVD* cardiovascular disease, *COPD* chronic obstructive pulmonary disease

mesh, including colpopexy/hysteropexy and vaginal mesh repair ($n = 439$, 63.4%) was significantly higher than that in the other two types of procedures in which patients did not receive mesh (81 ± 76 ml vs 61 ± 70 ml, $P = 0.006$). Proportion of patients who underwent colpopexy/hysteropexy and vaginal mesh repair with blood loss≥200ml were 15.0% and 10.7% respectively (P=0.157). When looking further into colporrhaphy and vaginal mesh repair, there is no significant difference in intra-operative blood loss or hemoglobin drop, but RBC loss is greater when using mesh ($P = 0.007$). Most of our sacrospinous ligament suspension procedures were conducted concomitantly with vaginal repair with or without mesh ($n = 44$). When taking sacrospinous ligament fixation into account, no significance relation has been found with operative blood loss, hemoglobin drop or RBC loss.

There is no difference in surgical blood loss or hemoglobin drop between anterior and posterior vaginal mesh use ($P > 0.05$). Furthermore, concomitant vaginal hysterectomy caused more intraoperative blood loss during surgery in vaginal mesh repair, as shown in Table 3.

The colpopexy ($n = 98$) and hysteropexy ($n = 42$) were performed by laparoscopy. In patients receiving colpopexy, apart from 3 patients who had a previous history of hysterectomy, hysterectomy was performed laparoscopically. No statistical difference in blood loss or RBC loss is found between colpopexy and hysteropexy.

Colpocleisis showed less surgical blood loss and RBC loss than colporrhaphy, but there was no statistical difference (P = 0.503). However, hemoglobin drop in colpocleisis was significantly less than in the other three types of procedures ($P < 0.05$). When looking further into colpocleisis, 109 patients (61.9%) who underwent complete colpocleisis with concomitant VH were found to have greater surgical blood loss, hemoglobin drop, and RBC loss, as shown in Table 4.

Table 2 Bleeding complications in pelvic floor reconstructive surgery

	Colpocleisis ($n = 176$)	Colpopexy /hysteropexy with mesh ($n = 140$)	Colporrhaphy ($n = 77$)	Vaginal mesh repair ($n = 299$)
Blood loss (ml) ± SD	55 ± 65	89 ± 82	72 ± 83	76 ± 72
Blood loss ≥200 ml, *n* (%)	9 (3.4)	**21 (15)**	6 (8.1%)	**32 (10.7)**
Hemoglobin drop (g/L) ± SD[a]	13 ± 11	19 ± 9	18 ± 17	22 ± 12
RBC loss ± SD	175 ± 140	236 ± 117	217 ± 106	276 ± 143
Hematoma, *n* (%)	1 (0.6)	0	0	5 (1.7)
Transfusion	0	2	0	2

[a] Hemoglobin drop is the postoperative hemoglobin value minus preoperative hemoglobin value

P=0.157

Table 3 Anterior or posterior wall mesh repair with or without hysterectomy

	Hysterectomy ($n = 185$)	Non-hysterectomy ($n = 114$)	*P*
Age ± SD	65 ± 6	65 ± 7	0.086
Blood loss (ml) ± SD	86 ± 75	58 ± 62	0.008
Hemoglobin dropping (g/L) ± SD	23 ± 13	19 ± 10	0.067
RBC loss ± SD	291 ± 145	249 ± 138	0.874

Table 4 Colpocleisis with or without hysterectomy

	Hysterectomy ($n = 109$)	Non-hysterectomy ($n = 67$)	P
Age ± SD	75 ± 6	76 ± 5	0.641
Blood loss (ml) ± SD	66 ± 74	39 ± 43	0.007
Hemoglobin dropping (g/L) ± SD	15 ± 12	11 ± 9	0.006
RBC loss ± SD	196 ± 150	140 ± 117	0.010

There were 4 (0.6%) patients in total who received blood transfusion during or after surgery, and all had undergone colpopexy/hysteropexy or vaginal mesh repair, as shown in Table 2.

Six patients (0.9%) developing hematoma after the operation were shown in Table 5, all of whom underwent concomitant VH. One patient received complete colpocleisis, and the other 5 patients all received mesh implanted in the anterior vaginal wall, including one patient who had mesh implanted in the posterior wall as well. All hematomas were diagnosed by trans-vaginal ultrasound, and were mostly located at the vaginal cuff. Patients complained of postoperative abdominal bloating, newly developed pain, and ecchymosis. Four patients developed postoperative fever over 38 °C. The average blood loss and hemoglobin drop are 83 ± 41 ml and 46 ± 22 g/L respectively. Only one patient's hematoma volume was more than 200 ml, with only 100 ml blood loss during surgery. However, her hemoglobin dropped from 153 g/L to 69 g/L and she received transfusion postoperatively. All patients were given antibiotics and hemostatics, and their conditions were stable afterwards.

Discussion

Repair surgery for POP is safe and effective with low complications. Our study shows a much lower blood loss during surgery, with an average blood loss of 72.9 ± 74.3 ml. This may be related to the length of experience of surgeons. All the surgeries were performed by three skilled surgeons with more than 10 years' experience in urogynecology. According to our experience, blood loss of more than 200 ml is abnormal; thus, we used 200 ml as a cutoff in addition to the standard blood loss of more than 500 ml.

Colpocleisis shows a higher successful rate and lower risks of complication than other types of pelvic reconstructive procedures, and is therefore performed in many elderly patients [5, 6]. However, the role of concomitant hysterectomy remains controversial. The benefits of VH include reducing the future risk of endometrial or cervical malignancy. However, some studies showed more complications, such as blood loss with VH [7–9]. In previous studies, the difference in blood loss could reach 100–150 ml [7, 10]. Our findings show that the difference in blood loss during surgery is 27 ml, perioperative RBC loss being 56 ml, and perioperative blood loss being 160 ml (hematocrit = 35%).

Previously reported incidence of symptomatic hematoma after pelvic constructive surgery was 6%, which was closely related to VH [11]. Vault hematoma occurred in 19.4 to 98% of patients undergoing VH, the indications for which were not limited to POP [12–15]. All 6 of the patients who developed symptomatic hematoma in our study received concomitant VH, including 1 patient with hematoma after colpocleisis. Compared with the previous study, concomitant VH may cause more hemorrhagic complications in colpocleisis and vaginal mesh repair. VH involves excision of some major vessels, and the bleeding from the vault could not be directly visualized by surgeons, which may to some extent influence the effect of hemostasis. Postoperative hemoglobin drop, transfusion, and postoperative fever are the usual problems related to hematoma [12–14]. Previous studies showed that techniques such as the double suturing of the vaginal cuff may significantly reduce the occurrence of pelvic hematoma after VH [16, 17].

Table 5 Characteristics of patients who developed hematoma

	Age	Comorbidity	Procedure	Symptom	Blood loss (ml)	Hemoglobin dropping (g/l)	RBC loss	Volume (ml)
1	77	Hypertension Diabetes	Colpocleisis + vaginal hysterectomy + vaginal left salpingo-oophorectomy	Bloating	50	36	480	148
2	61	Hypertension Diabetes	Vaginal hysterectomy + anterior and posterior vaginal mesh repair + sacrospinous ligament suspension	Peri-anal pain	150	25	301	25
3	69	Diabetes	Vaginal hysterectomy + anterior vaginal mesh repair + posterior colporrhaphy	Ecchymosis in the left lower limb and hip	50	53	586	64
4	63	None	Vaginal hysterectomy + anterior vaginal mesh repair + posterior colporrhaphy	Bloating	100	47	610	47
5	66	Hypertension	Vaginal hysterectomy + anterior vaginal mesh repair + posterior colporrhaphy	Bloating	100	84	826	211
6	62	None	Vaginal hysterectomy + anterior vaginal mesh repair	Pain in the skin wound	500	78	885	81

Apart from VH, mesh use may be another important risk factor for hemorrhagic complications. Pelvic floor reconstructive surgeries using mesh had a higher possibility of developing short-term (<30 days) complications (9.28% vs 6.15%, $p < 0.001$) [18]. In previous studies, the transfusion rate in surgeries using transvaginal mesh ranged from 0.44 to 2.5% [19–22]. However, a large systematic review reported no evidence of a difference between the mesh and the native tissue repair groups in the rate of blood transfusion (RR 1.55, 95% CI 0.88 to 2.72, 6 RCTs, $n = 723$, $I^2 = 0\%$) [23]. Our study also shows greater intra-operative blood loss during surgery using mesh, and all 4 cases requiring transfusion (0.6%) received mesh, accounting for 0.9% of all mesh cases.

Higher rates of intraoperative bleeding, pelvic hematoma, and transfusion in mesh repair may be attributed to three causes. First, major vessel injuries during puncturing have been reported during mesh placement [19]. Commonly injured vessels included inferior gluteal vessels, obturator vessels, and paraurethral venous plexus. Second, more dissection was required to implant mesh in the right location. Finally, biocompatibility deficiency of polypropylene (PP), a widely used material for mesh, may lead to poor hemostasis, hemolysis or thrombosis formation compared with native tissue repair. As for a polypropylene mesh that has recently come into use in pelvic floor reconstructive surgeries, titanium-coated PP mesh was suggested by the manufacturer with a high degree of biocompatibility [24]. However, no significant superiority has been proved. Within 299 patients who underwent anterior or posterior wall repair with mesh, only 12 patients received porcine small intestine submucosa mesh, and the rest of the patients received polypropylene mesh. It is statistically not feasible to compare the actual type of mesh used. Larger sample size and prospective data are required to analyze the difference in mesh implantation process, hemocompatibility, and their effects on bleeding complications.

There is no difference in blood loss between anterior or posterior mesh in our study. Although a few previous studies report hematoma after anterior wall mesh use alone, and in all 5 of our patients who developed hematoma after mesh repair the anterior vaginal wall was involved, with only 1 patient receiving mesh in the posterior wall, current data could not provide enough evidence to show whether the location of mesh is a risk factor for hematoma formation [25].

Operating with more precision is very critical to decreasing hemorrhage, especially in dissection. Other measures that were taken to prevent hematoma related to VH include vaginal pack insertion on the vaginal cuff and prophylactic antibiotic use [11, 16, 17]. In our institute, vaginal packing was routinely employed in all the patients for 48 h except those who received colpocleisis, which could reduce postoperative bleeding from both the vaginal vault and the vaginal wall.

In conclusion, concomitant VH and mesh use are two major surgical risk factors for hemorrhagic complications of pelvic reconstructive procedures including hematoma. Colpocleisis is performed in the elderly because of its lower complication rate, but concomitant hysterectomy could increase the risk of hemorrhagic complications. Whether it is necessary to conduct hysterectomy for potential malignancy requires more prospective research.

Compliance with ethical standards

Conflicts of interest None.

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