Chapter

Peripartum Hysterectomy

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Abstract

Peripartum hysterectomy is a lifesaving surgical procedure that is performed during or immediately after childbirth. Although it is a rare event, it is associated with significant maternal morbidity and mortality. This chapter provides a comprehensive overview of the indications, techniques, and outcomes of peripartum hysterectomy. It also discusses the risk factors, prevention strategies, and management of complications associated with this procedure. The chapter is a valuable resource for obstetricians, gynecologists, and other healthcare professionals involved in the care of pregnant women. It provides evidence-based recommendations and practical guidance to help improve the outcomes of peripartum hysterectomy and ultimately save lives.

Keywords: peripartum hysterectomy, obstetric hemorrhage, cesarean hysterectomy, abnormal placentation, "near-miss" patients

1. Introduction

Life-threatening hemorrhage during or immediately after abdominal or vaginal deliveries is the major cause of maternal morbidity and mortality [1]. Different medical and surgical interventions have been developed to control the hemorrhage, but unfortunately, the removal of the corpus uteri alone or with the cervix at the time of a cesarean section or within the puerperium may be needed as a last resort in saving a woman's life [2]. This procedure is called *peripartum hysterectomy* (PH). On the other hand, if the procedure is performed at cesarean section, it is referred to as *cesarean hysterectomy*, while after vaginal birth, it is called as *postpartum hysterectomy*.

Although the operation may occur as a planned procedure, it is mostly performed in emergency situations to control life-threatening hemorrhage as a lifesaving procedure [3]. Massive hemorrhage and the need to perform the surgery expeditiously create unsuitable conditions both for the surgeon and for women [1].

2. History

Peripartum hysterectomy was first proposed by Joseph Cavallini in 1768 for use in animal models. In 1823, James Blundell demonstrated the feasibility of the idea through experiments conducted on rabbits. Although the method was attempted in humans in 1869, unfortunately, the patient succumbed at the 68th hour following the surgery performed by Storer [4, 5].

The first cesarean hysterectomy in which both the mother and the baby survived was performed by Eduardo Porro from Milan in 1876. During the surgery, Porro passed a wire through the cervix, sufficiently tightening it to control bleeding. He then cut the uterus from above and sutured the stump with silver sutures. As a result, the first human to successfully undergo a cesarean hysterectomy and survive was Julia Cavallini, a 25-year-old dwarf measuring 144 cm in height [1, 4, 5].

Subsequently, the method underwent further modifications by numerous surgeons worldwide.

3. Incidence

The prevalence of PH is reported more frequently in low-resource countries compared to developed countries. In a systematic review and meta-analysis, the estimated overall weighted mean prevalence was reported as 0.9 per 1000 deliveries. Prevalence ranged from 0.2 in some Scandinavian countries to 10.1 per 1000 deliveries in India [6]. Possible reasons for these observed variations are listed in **Table 1** [6, 7].

Additionally, PH is more performed after cesarean section compared to vaginal deliveries [8]. The higher PH rates associated with cesarean sections can be attributed to a higher occurrence of abnormally invasive placentation in these women [1].

If we focus on factors influencing the incidences of peripartum hysterectomies, a strong correlation was observed between the national cesarean section rate and the prevalence of peripartum hysterectomy [9]. Hospitals with high delivery volumes and high rates of hysterectomies saw the largest increases in peripartum hysterectomy rates [10].

Overall, the prevalence or incidence of peripartum hysterectomy is influenced by various factors such as the rate of cesarean section, previous cesarean section, and hospital delivery volume.

4. Indications and risk factors

In a systematic review and meta-analysis, the overall mean maternal age ranged from 26.2 to 37.9 years, the weighted mean gestational age was reported at 37.0 weeks of gestation, and the weighted mean parity was observed at 4.0 [6].

Uterine atony was reported as the principal indication for PH, but it has changed toward abnormal placentation. Indications for PH are summarized in **Table 2** [6].

Differences in standards of antenatal care
Differences in standards of obstetric care
Differences in rates of cesarean delivery
Differences in parity, maternal age
Lack of blood banking facilities
Unavailability of advanced conservative interventional methods

Table 1.
Possible reasons for observed variations in incidences of PH.

Indication	%
Placental pathology	38
Abnormally invasive placenta	19
Placenta previa	10
Combined or unspecified placental pathology	8
Placental abruption or couvelaire uterus	1
Uterine atony	27
Uterine rupture	26
Unspecified hemorrhage	5
Infection	2
Cervical tear or laceration	1
Myomas or myomas with major obstetric hemorrhage	1
Disseminated intravascular coagulation	1
Hematoma	1
Abnormal pregnancy	1

Table 2.
Indications for PH.

An elective PH may be performed if abnormal placentation is diagnosed in the antepartum period. Occasionally pregnant women with stage IA2 and IB1 cervical carcinoma are candidates for an elective PH [11]. Severe postpartum infection unresponsive to medical therapy and placental site vessel subinvolution is other potential indications for elective PH [11–13]. Also, giving birth with cesarean section is associated with a fourfold risk compared to vaginal delivery [14].

4.1 Abnormal placentation

In addition, 59.8% of patients with adherent placenta and 75% with placenta previa have a history of previous cesarean section. The high incidence of PH is directly related to the increasing number of cesarean sections [15]. It has been reported that the incidence of placenta previa after one previous cesarean section increases by 47-fold in patients with four previous cesarean section [1]. Similarly, patients with previous surgical abortions were found to be more likely to have abnormal placentation. The risk is even higher in patients with multiple surgical abortions [16].

Multiparity
Oxytocin use for uterine stimulation
Preeclampsia
Multiple gestation
Prolonged labor

Table 3.
Independent risk factors for uterine atony.

Patients with only placenta previa have 16% risk of undergoing PH, but this risk rises up to 16% in patients with placenta previa and scarred uterus [17].

4.2 Uterine atony

While uterine atony was traditionally the most frequent indication for PH, its occurrence has declined due to newly developed pharmacological management facilities. Independent risk factors for uterine atony are listed in **Table 3** [14, 18].

4.3 Uterine rupture

11.4% to 45.5% of patients with uterine rupture may undergo PH. The risk factors for uterine rupture are multiple previous cesarean sections with a scarred uterus [1].

5. Preoperative evaluation

Even though it is a lifesaving operation, preoperative assessment techniques possess a key role in determining the success of the surgery. It is not always possible for the surgeon to take all the preventive measures before each case as the nature of the procedure is almost every time emergent. However, the factors listed below are recommended to be evaluated before each high-risk delivery:

1. Risk stratification: Preoperative planning and risk stratification models are essential to minimize the risk of undergoing hysterectomy and to reduce the morbidity associated with the procedure [19].

2. Clinical audit: Clinical audit can be used to evaluate the clinical management preceding peripartum hysterectomy and to determine if peripartum hysterectomies are potentially avoidable and by which means [20].

3. Imaging studies: In some cases, imaging studies such as ultrasound or MRI may be used to confirm the diagnosis or to identify the underlying cause of the bleeding [21].

4. Multidisciplinary approach: A multidisciplinary approach with ICU backup may improve outcomes [22].

5. Evaluation of risk factors: Evaluation of risk factors such as previous cesarean section, abnormal placentation, uterine atony, maternal coagulopathy, and maternal age may help in identifying women at high risk for peripartum hysterectomy.

6. Assessment of maternal and fetal risks and benefits: The decision to perform a peripartum hysterectomy should be made in consultation with a multidisciplinary team, including obstetricians, anesthesiologists, and hematologists, and should take into account the maternal and fetal risks and benefits [22].

6. Surgical technique

6.1 Position

Hysterectomy should be performed in the low lithotomy position. This position offers several advantages: (a) It allows for a thorough examination of patients with postpartum hemorrhage. It is an ideal position for identifying the source of bleeding. Lower genital tract lacerations and atonic bleeding are more easily recognized in this position. Additionally, transvaginal ultrasonography can be comfortably performed, facilitating the identification of upper intraperitoneal or extraperitoneal hematomas. (b) In cases of active bleeding, until the abdominal incision is initiated, this position enables the application of bimanual or vaginal tampons. (c) It is suitable for surgical interventions via the vaginal route. For cervical tears, cervical suturing can be performed, and in cases of deep vaginal tears, access to the pararectal or paravesical spaces can be achieved vaginally for necessary interventions and suturing. (d) This position provides advantages for surgical interventions via the abdominal route. Avascular spaces can be more easily accessed, allowing for better visualization of the topographic anatomy. This not only facilitates easier interventions but also reduces the risk of complications. Specifically, in cases with significant volume deficit requiring arterial ligation or placental invasion anomalies, this position is more advantageous for reducing bleeding and preventing complications. Furthermore, in placental invasion anomalies, the low lithotomy position is more beneficial during bladder dissection than the normal position.

6.2 Surgical site preparation

Povidone-iodine or chlorhexidine can be used for surgical site preparation. There is evidence suggesting the superiority of chlorhexidine, but these findings do not specifically pertain to postpartum hemorrhage surgery. It is known that the recovery of vaginal flora is parallel to vaginal cuff infections. Vaginal recolonization occurs more rapidly with chlorhexidine compared to povidone-iodine. Therefore, chlorhexidine can be used to reduce the risk of postoperative surgical site infections in these cases.

6.3 Antibiotic prophylaxis

The recommended regimen for prophylaxis is cefazolin 1 gram, and in cases where the surgical duration is prolonged, or the preoperative estimated blood loss exceeds 2 liters, or the intraoperative blood loss exceeds 2 liters, a 2-gram additional dose is advised.

6.4 Incision

The choice of incision is crucial for accessing the abdomen in the surgical management of postpartum hemorrhage. Especially in cases of placental invasion anomalies and complicated bleeding, a vertical incision is recommended to achieve complete and comfortable pelvic exposure. With this incision, dissection of the pelvic sidewall, particularly the vascular structures, can be performed more easily, and vascular

clamping or ligations can be readily carried out. Additionally, preserving the integrity of the placenta is of utmost importance for the surgical management of placental invasion anomalies to prevent sudden bleeding. To achieve this, the fetus is delivered through an incision made from an area without the placenta, facilitated by the vertical incision. In cases of placenta accreta spectrum (PAS), after a vertical incision is made, the fetus is delivered through a fundal incision, ensuring the preservation of placental integrity and protecting the patient from sudden bleeding. In addition to these recommendations, experienced surgeons particularly prefer transverse incision in PAS cases. After entering the abdomen through a transverse incision, the fetus is delivered through a transverse incision just above the termination of the placenta. The remaining parts of the hysterectomy can be completed without compromising placental integrity. This technique can yield advantages such as reduced bleeding and improved cosmetic outcomes. Transverse incisions are also utilized in our clinic. For cases of uterine atony, a transverse incision is recommended. With this incision, procedures such as hysterectomy, arterial ligations, or compression sutures can be easily performed in cases of uterine atony. In situations where sufficient exposure is not achieved with the classic Pfannenstiel incision, relaxation of the rectus abdominis muscles can further facilitate access to the pelvis.

6.5 Retroperitoneal dissection with round ligament incision

During hysterectomy, the first structure usually incised is the round ligament. The round ligament incision allows for entry into the retroperitoneum by cutting the broad ligament parallel to the infundibulum of the ligament. Initially, the m. psoas muscle should be identified from this entry point. Then, the a. iliaca externa and v. iliaca externa, which run immediately medial to the muscle, should be easily located. Subsequently, the broad ligament is pushed medially, and separation from the external vascular structures is attempted. This enables the visualization of the ureter adhered to the broad ligament. Further dissection medially along the ureter reveals the a. iliaca interna just below, and entry into the pararectal avascular space between the a. iliaca interna and the ureter is achieved. This dissection allows for easy ligation of the a. iliaca interna for subsequent control of pelvic bleeding after hysterectomy. When following the a. iliaca interna anteriorly, the umbilical artery will be visible, and by dissecting the umbilical artery medially while keeping the a. and v. iliaca externa laterally, the paravesical space can be reached. In the inferior aspect of the paravesical space, the a. and v. obturatoria are found, while caudally, an aberrant v. obturatoria is present in approximately 30% of cases, along with the n. obturatorius in the inferior aspect. The exploration of this space also allows control over the paravaginal region in an inferio-caudal direction, facilitating the evacuation of hematomas, repair of tears, and suture ligation of ongoing bleeding in this area.

7. Special concerns

7.1 Total or subtotal hysterectomy?

Total abdominal hysterectomy is the procedure of choice, but subtotal PH may be a better choice in certain conditions where surgery needs to be completed in a shorter time. The advantages and disadvantages of subtotal PH are summarized in **Table 4** [1].

Advantages	Disadvantages
Lesser blood loss	Risk of malignancy in the residual stump
Reduced need for blood transfusion	Bleeding/discharge from residual stump
Reduced operating time	Need for regular cytology
Less intra and postoperative complications	Not effective in accreta in lower uterus

Table 4.
Advantages and disadvantages of subtotal PH.

Morbidity	%
Blood transfusion	88
Febrile episodes	26.5
Bladder injuries	8.8
DIC	
Ileus	
Vaginal cuff bleeding	
Adnexectomy	

Table 5.
Causes of morbidity with PH.

Both total and subtotal hysterectomy are associated with high morbidity and mortality [13]. Mean maternal mortality is reported to be about 4.8%. The causes of morbidity are listed in **Table 5** [17].

7.2 Role of vessel sealing devices

Based on the studies reviewed, vessel sealing devices have been shown to be effective and safe in achieving hemostasis during peripartum hysterectomies. They have been found to reduce operative time, blood loss, and the need for blood transfusions [23, 24]. Also, one of the studies claim they also reduce the number of intraoperative complications [23], while the other confines the benefit as not yet causing an increase [24]. The use of vessel sealing devices may be useful in both total and subtotal hysterectomies. However, it is important to note that vessel sealing devices should be used with caution and proper training to avoid complications such as thermal injury to adjacent tissues.

7.3 Who bleeds more?

Limited studies have been conducted to predict which cases are more prone to increased bleeding during peripartum hysterectomies. The data obtained from these studies are generally retrospectively designed due to ethical reasons and has limited evidence levels. However, it is known that the most effective factors contributing to increased bleeding are the necessity of performing hysterectomy in emergency conditions, limitations in preoperative preparations, and multidisciplinary approach.

As a notable finding, it has been observed that patients who have not previously undergone cesarean delivery surprisingly experience more bleeding during surgery.

Additionally, other factors that contribute to increased bleeding include the absence of intra-arterial balloon usage, the presence of known coagulation disorders in the patient, and awareness of the patient's desire to maintain fertility [25, 26].

For effective control of bleeding during peripartum hysterectomies, early diagnosis, appropriate interventions, and a multidisciplinary approach involving obstetricians, anesthesia specialists, and hematologists are important. However, further research and comprehensive studies are needed to better understand the risk factors for bleeding in peripartum hysterectomies and to develop management strategies.

7.4 Effect of body mass index

Class III obesity is an independent risk factor for increased morbidity at the time of peripartum hysterectomy, including the need for intensive care unit admission and readmission within 30 days [27]. According to the literature, although estimated blood loss and the number of transfusions do not differ depending on the patient's body mass index, there is a significant increase in surgical times and the number of wound infections.

7.5 Effect of assisted reproductive technologies

The role of assisted reproductive technologies (ART) in the risk of peripartum hysterectomies is a subject of study and debate. Although there is no consensus, several factors related to ART have been suggested as potential contributors to the increased risk of peripartum hysterectomies. Although the absolute risks are low, there is an almost fivefold increased risk of unplanned peripartum hysterectomy, and 1,7 more unplanned peripartum hysterectomies occur per 1000 deliveries in pregnancies with ART compared to those without ART. It is important to note that the exact contribution of ART to the risk of peripartum hysterectomies is still being researched, and individual cases may vary. Women undergoing ART should receive thorough prenatal care and should be closely monitored for potential complications [28, 29].

7.6 Preventive measures against venous thromboembolism (VTE)

Peripartum hysterectomy is associated with a significantly increased risk of VTE in the postpartum period, even when controlling for other known risk factors for postpartum thromboembolic events. The incidence of VTE following peripartum hysterectomy observed in a cross-sectional study with a big cohort shows that the population (2.2%) meets some guideline-based risk thresholds for routine thromboprophylaxis, potentially for at least two weeks postpartum. Further investigation into the role of routine VTE prophylaxis during and beyond the delivery encounter is needed [30].

7.7 Role of abdominal packing after peripartum hysterectomy

The scientific evidence suggests that abdominal packing can effectively control bleeding after peripartum hysterectomy in cases of intractable hemorrhage. Abdominal packing techniques include pads or roller gauze and balloon packs and abdominal packs retrieved within 24–48 hours. Studies have shown that abdominal packing can be successful in controlling bleeding after peripartum hysterectomy, even in cases where bleeding persists after the hysterectomy. However, there are potential

risks associated with abdominal packing, such as infection and embolization of nontargeted vessels. The decision to use abdominal packing should be individualized based on the patient's clinical presentation and medical history [31, 32].

In a study that included more than a million deliveries consisting of 718 peripartum hysterectomies and 53 abdominal packing operations (about 1 per 14 hysterectomies), the success rate of abdominal packing was 62%, and the mortality rate was 24%. Other patients required other measures of interventions. The study concluded that abdominal packing was considerably helpful to physicians in means of being an option as a lifesaving procedure. The mean time for preserving the packing was 39 hours postpartum [31].

Some surgeons depend on modifications to abdominal packing procedures in the literature. In a six-patient case study, authors wrapped hot fluid-soaked and squeezed packing material circularly around a Bakri-type balloon and stabilized it, applying gentle pressure around the whole pelvic vasculature using the vaginal route. The estimated amount of bleeding was limited compared to the conventional packing procedure, and the method was useful in five patients [33].

7.8 Role of uterine compression sutures

The scientific evidence suggests that uterine compression sutures can effectively avoid cesarean hysterectomy in cases of intractable postpartum hemorrhage. Uterine compression sutures involve the placement of sutures around the uterus to compress the bleeding vessels and reduce bleeding. Several studies have evaluated the efficacy and safety of uterine compression sutures in preventing cesarean hysterectomy and reducing morbidity and mortality associated with postpartum hemorrhage. The benefits of uterine compression sutures include preservation of fertility, avoidance of hysterectomy, and ease of application. However, there are also potential risks associated with uterine compression sutures, such as infection, uterine rupture, and decidual cast formation [34].

Studies have shown that uterine compression sutures with additional hemostatic procedures can effectively control postpartum hemorrhage and prevent hysterectomy [35]. The B-Lynch suture technique and modified Pereira suture have also been reported to be effective alternatives to cesarean hysterectomy [36]. However, these methods are only recommended as first-line interruptions and will cause of losing valuable time during the management of patients with severe PAS and ones who already lost a considerable amount of blood.

7.9 Prophylactic intraoperative uterine artery embolization (UAE)

Prophylactic intraoperative uterine artery embolization during cesarean hysterectomy is a technique used to reduce the risk of intraoperative bleeding and complications in cases where cesarean delivery and subsequent hysterectomy are anticipated to be challenging or associated with a high risk of bleeding. The procedure involves the selective occlusion of the uterine arteries using embolic materials to decrease blood flow to the uterus.

The role of prophylactic intraoperative UAE is to limit blood loss during the surgical procedure by reducing blood flow to the uterus. By temporarily blocking the uterine arteries, the blood vessels that supply the uterus, the procedure aims to minimize the risk of excessive bleeding, which can be particularly challenging in cases of placenta accreta, increta, or percreta, where the placenta is abnormally attached to

the uterine wall [37]. Several studies have evaluated the efficacy and safety of UAE in preventing cesarean hysterectomy and reducing morbidity and mortality associated with PAS [38]. The benefits of UAE include decreased blood loss, reduced morbidity, and preservation of fertility in some cases. However, there are also potential harms associated with UAE, such as the risk of embolization of nontargeted vessels, uterine necrosis, and infection [39].

7.10 Postoperative care

Based on the studies reviewed, the postoperative care measures after peripartum hysterectomy may include: (a) Monitoring for complications: Patients who undergo peripartum hysterectomy should be closely monitored for complications such as postoperative febrile illness, bladder injury, disseminated intravascular coagulation, acute kidney injury, wound infection, and maternal death. (b) Intensive care: A significant proportion of women who undergo peripartum hysterectomy may require intensive care postoperatively. (c) Correction of anemia: Correction of anemia before and after surgery may help to reduce the risk of complications and improve outcomes. (d) Blood transfusions: Liberal use of blood components may be necessary to manage hemorrhage and prevent complications. (e) Correction of coagulopathy: Correction of coagulopathy may be necessary to prevent bleeding and other complications. (f) Pain management: Adequate pain management should be provided to ensure patient comfort and facilitate recovery. (g) psychological support: Patients who undergo peripartum hysterectomy may experience anxiety and worry and may benefit from psychological support. (h) Follow-up care: Patients who undergo peripartum hysterectomy should receive appropriate follow-up care to monitor for complications and ensure optimal recovery. (i) Prevention of future complications: Measures to prevent future complications, such as improved antenatal care and identification of risk factors for peripartum hysterectomy, should be implemented [1, 9, 40].

7.11 Postoperative emotional burden

There is limited evidence on the emotional responses and depression after peripartum hysterectomy. However, some studies have reported on the postoperative complications and morbidity associated with peripartum hysterectomy, which may have an impact on emotional well-being [41, 42]. A study originated from a local nontertiary hospital reported on a surveillance questionnaire that indicated increased depression rates in peripartum hysterectomy patients compared to patients who had complicated cesarean deliveries [43]. Another questionnaire-based study showed women with peripartum hysterectomy had higher rates of emotional stress including fear, numbness, problems with bonding with the infant and delay in emotional reactions even after 6 months postpartum. All studies point out that women with peripartum hysterectomies need long-term psychological support [40].

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