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Risk of peripartum hysterectomy by mode of delivery and prior obstetric history: data from a population-based study

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Abstract
Purpose To provide an estimate of the incidence of peripartum hysterectomy in the state of New Jersey and calculate the effect of mode of delivery and prior obstetric history.
Methods A perinatal-linked dataset provided by the Maternal Child Health Epidemiology Program in the New Jersey Department of Health was used to obtain information from birth certificates and hospital discharge records. Using multivariate logistic regression, various demographic and clinical factors were assessed for association with peripartum hysterectomy.
Results A total of 1,004,116 births were identified between 1997 and 2005 and 853 peripartum hysterectomies were performed (0.85/1,000 deliveries). Parity increased the risk of hysterectomy with nulliparous women having approximately half the risk compared to multiparous women. Cesarean delivery with no previous c-section almost doubled the risk (OR 2.20, CI 1.80–26.69) while in the presence of a previous c-section the risk was almost four times higher (OR 4.51, CI 3.76–5.40). Operative vaginal delivery did not result in any increase in the risk.
Conclusions Mode of delivery and prior obstetric history are major risk factors for peripartum hysterectomy. Patients desiring cesarean delivery need to be counseled on the risk of this serious complication.

Keywords Peripartum hysterectomy · C-section · Placenta previa · Population-based study

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Introduction

Peripartum hysterectomy, the surgical removal of the uterus during the peripartum period, is one of the most severe obstetrical complications. It is associated with intraoperative hemorrhage, surgical complications as well as prolonged length of stay. Despite its significant association with increased maternal morbidity and mortality, it is a potentially life saving procedure. Peripartum hysterectomy (PH) was historically performed to control life-threatening hemorrhage secondary to uterine atony, although recent studies suggest an increase in its use for the management of complications of abnormal placentation [1, 2]. Few studies have investigated the effect of cesarean delivery, particularly a repeat cesarean delivery, in increasing the risk of hysterectomy. Providing an accurate estimate of the risk is essential for patient counselling in the era of patient choice cesarean sections. An exhaustive literature search revealed an incidence rate

ranging from 0.2 to 5.4 per 1,000 births. Some of the most important recent studies on PH can be seen in Table 1. The majority of this data is from retrospective case-series. A serious limitation of these studies is the extraction of data from a single institution, which can lead to inaccuracy in incidence calculations. It is well known [3] that individual physician practice patterns or patient characteristics may influence the decision to perform a peripartum hysterectomy. A population-based analysis using the cohort of all the deliveries in a large geographic area as the study population may overcome some of these limitations.

Therefore the purpose of this study is to provide a statewide estimate of the incidence of peripartum hysterectomy in the state of New Jersey and to assess the impact of mode of delivery, whether this is vaginal, cesarean section or repeat cesarean to the risk of peripartum hysterectomy using a large database of hospital discharge summaries, and birth certificates.

Materials and methods

The source of data was a perinatal-linked dataset provided by the Maternal Child Health Epidemiology (MCH Epi) Program in the New Jersey Department of Health and Senior Services. The perinatal-linked file contains information from birth certificates and hospital discharge records for mother and newborn born in New Jersey for the years 1997–2005. Records linkage was achieved via probabilistic matching using AutoMatch software. The linked file contains a total of 1,004,116 births between 1997 and 2005. Peripartum hysterectomy was identified as hysterectomy and delivery occurring during the same hospital admission.

Univariate analyses were performed using Chi-square test on various demographic and clinical factors in order to identify the primary factors associated with peripartum hysterectomy. The analysis plan was as follows: (1) descriptive analyses intended to compare the outcome

Table 1 Rates of peripartum hysterectomy in various studies

Publication date	Study	Country	Study period	Deliveries (*n*)	PPH (*n*)	PPH rate per 1,000	Leading cause	Type of study
2010	Stivanello et al. [17]	Italy	2003–2006	151,494	131	0.86		Retrospective
2010	Zwart et al. [18]	Netherlands	2004–2006	371,021	108	0.3	Obstetric hemorrhage	Prospective cohort
2009	Bodelon et al. [19]	USA	1987–2006	–	896	0.25–0.82	Placenta previa	Population-based case–control
2009	Flood et al. [1]	Ireland	1966–2005	827,379	358	0.4	Placenta accreta	Retrospective cohort
2008	Glaze et al. [2]	Ireland	1999–2006	108,154	87	0.8	Uterine atony	Retrospective cohort
2008	Rahman et al. [20]	Saudi Arabia	1982–2006	67,668	43	0.64	Abnormal placentation	Retrospective
2008	Kayabasoglu et al. [4]	Turkey	2001–2007	74,462	28	0.37	Abnormal placentation	Retrospective
2007	Sakse et al. [21]	Denmark	1995–2004	653,582	152	0.24	Uterine atony in nullips; placenta accreta in multips	Retrospective cohort
2006	Kwee et al. [11]	Netherlands	2002	110,937	48	0.33	Placenta accreta	Prospective cohort
2006	Whiteman et al. [3]	USA	1998–2003	23,816,883	18,339	0.77	Hemorrhage	Retrospective cohort
2006	Eniola et al. [9]	United Kingdom	1997–1998	48,865	22	0.45	Uterine atony	Prospective cohort
2006	Yucel et al. [7]	Turkey	1995–2003	117,095	34	0.29	Uterine rupture	Retrospective
2005	Francois et al. [16]	USA	1996–2001	43,927	100	2.28	Placental invasion in singletons; atony among multiples	Retrospective cohort
2003	Forna et al. [8]	USA	1990–2002	70,449	55	0.8	Uterine atony	Retrospective cohort
2003	Kacmar et al. [10]	USA	1983–1998	122,025	79	0.6	Uterine atony	Case–control

groups (PH vs. non-PH), (2) bivariate tests of association and stratified analyses for the dichotomous outcome measure, and (3) multivariate logistic regression. In the regression model, the risk of PH in terms of mode of delivery and prior obstetric history in the presence of potential confounding factors were assessed. Logistic regression was performed to control the effect of age, race, parity, birth weight and mode of delivery.

Results

For the study period of 1997–2005, a total of 853 peripartum hysterectomies were performed in the state of New Jersey, corresponding to a rate of 0.85 per 1,000 deliveries. The estimated number of deliveries during the same period was 1,004,116 among which 294,270 (29.5%) were cesarean sections. Approximately 18% of the patients had a primary cesarean section while repeat cesarean was performed in 11% of women in our population. The demographic characteristics of patients with and without peripartum hysterectomy can be seen in Table 2. Although the majority of patients with PH belonged to the age group of 21–35 years, the procedure was performed more frequently in the group of women older than 40 years of age. In a similar fashion, although most of the women that had a hysterectomy in our population were white, PH was more likely to be encountered in the group of African-Americans. In addition, 635 hysterectomies were performed in multiparous women, while only 35 women with more than 5 previous births (grandmultiparae) had a PH. Despite this, the incidence of PH in the latter group was almost double compared to the group of multiparous women. Another interesting observation is that the majority of hysterectomies was performed in patients who had a repeat c-section in the index pregnancy, while almost two-thirds of PH occurred in patients that delivered through a c-section compared to only one-third of them that were performed after a vaginal delivery. One in six patients that underwent a PH had placenta previa during the index pregnancy.

Parity was significantly correlated to the risk of PH with only 183 (21.4% of total cases) nulliparous women had this complication, while 635 (74.5%) multiparous women (1–4 previous pregnancies) and 35 (4.1%) grandmultiparas had PH. The difference in risk was statistically significant in both subgroups. In other words, nulliparous women had approximately half the risk of PH compared to multiparous women (Table 3).

There was a noticeable increase in the rate of PH with advancing maternal age, from 0.4 per 1,000 deliveries in patients aged 16–20 years to 2.7 per 1,000 deliveries for women aged 40 years or older. However, this was not statistically significant (adj. OR 1.35, 95% CI 0.41–4.40).

A cesarean delivery at the index pregnancy was associated with an increased risk (adj. OR 2.20, 95% CI 1.8–2.66). Risk also tended to be greater for patients with a history of a previous cesarean section (adj. OR 3.55, 95% CI 3.09–4.08) regardless of the mode of delivery at the index pregnancy. A repeat cesarean delivery at the index pregnancy conferred an incremental risk (adj. OR 4.51, 95% CI 3.76–5.40). The highest risk was noted in women with placenta previa at the index pregnancy undergoing repeat c-section; they were 44 times more likely to have a hysterectomy in the peripartum period. Placenta previa alone increased the odds of PH by 24-fold (adj. OR 23.79, 95% CI 19.4–29.1).

Operative vaginal delivery did not appear to increase the incidence of PH except in patients with a c-section in a previous pregnancy. Another interesting finding was that PH was almost twice as frequent in low birth weight pregnancies (<2,500 g) compared to pregnancies with normal birth weight (adj. OR 1.89, 95% CI 1.55–2.31).

Furthermore, although the risk for twin gestations was no different than for singletons, it was significantly increased for triplets (adj. OR 2.08, 95% CI 1.21–3.58).

Comment

The incidence of PH as reported in the current literature varies widely from 0.24 to 5.4 per 1,000 births. There is also significant variation across the world. The reported incidence in Turkey is 0.37 per 1,000 births [4], in Canada 0.8 per 1,000 deliveries [2] and in California 1.3 per 1,000 deliveries [5]. A comparison of recent studies on PH can be seen in Table 1. The variation in the reported incidence can be attributed not only to a difference in the obstetric practice, but to the inaccuracy of small retrospective case reviews performed in single institutions. Our study reports a rate of 0.85 per 1,000 deliveries, based on an analysis of all deliveries in the state of New Jersey over a decade.

Few studies have evaluated the compounding effect of a previous cesarean section in a patient with placenta previa undergoing a repeat cesarean delivery, even though previous cesarean section and placenta previa are well known risk factors individually. A cesarean section in a previous pregnancy increases the risk of peripartum hysterectomy almost twice as compared to women with previous vaginal delivery [6–9]. This result may be attributed to the increased risk of disorders of placentation including placenta accreta and percreta, which could lead to the necessity to perform a peripartum hysterectomy. A similar population-based study by Whiteman et al. [3] has shown an increased frequency of peripartum hysterectomy in patients undergoing trial of labor after a cesarean. Another explanation is that obstetricians would be more willing to

Table 2 Demographic characteristics of women with and without PPH and incidence of PPH in different groups

Characteristic	Patients ($N = 1{,}004{,}116$) (% of population)	Peripartum hysterectomy ($N = 853$) (% of group)	Incidence of PPH (per 1,000 deliveries)	p values
Age				
<16	4,613 (0.46%)	3 (0.3%)	0.6	0.824
16–20	95,298 (9.53%)	42 (5%)	0.4	<0.0001
21–35	745,644 (74.60%)	549 (64.4%)	0.7	<0.0001
36–40	131,915 (13.20%)	202 (23.6%)	1.5	<0.0001
>40	21,229 (2.12%)	57 (6.7%)	2.7	<0.0001
Race				
White	534,813 (53.51%)	458 (53.7%)	0.5	0.828
Black	157,538 (15.76%)	166 (19.4%)	1.1	0.003
Asian	211,994 (21.21%)	168 (19.7%)	0.8	0.333
Hispanic	78,529 (7.86%)	53 (6.3%)	0.7	0.091
Others	15,825 (1.58%)	8 (0.9%)	0.5	0.172
Birthweight (g)				
<2,500	76,823 (7.69%)	185 (21.6%)	2.5	<0.0001
2,500–3,499	538,039 (53.83%)	403 (47.3%)	0.7	0.0002
3,500–3,999	285,566 (28.57%)	195 (22.8%)	0.7	0.0004
4,000–4,499	84,089 (8.41%)	56 (6.5%)	0.7	0.066
4,500+	14,182 (1.42%)	15 (1.8%)	1	0.47
Parity				
Nulliparous	395,960 (39.61)	183 (21.4%)	0.5	<0.0001
Multiparous[a]	586,169 (58.64%)	635 (74.5%)	1.1	<0.0001
Grandmultip[b]	16,570 (1.66%)	35 (4.1%)	2.1	<0.0001
Method of delivery				
Vaginal delivery with no prior cesarean section	608,242 (61%)	244 (28.7%)	0.4	<0.0001
VBAC	27,227 (2.73%)	25 (2.9%)	0.9	0.771
Operative vaginal delivery with no prior cesarean section	59,726 (5.99%)	20 (2.5%)	0.3	<0.0001
Operative vaginal delivery with prior cesarean section	6,742 (0.68%)	7 (0.9%)	1	0.744
Cesarean delivery with no prior cesarean section	184,520 (18.51%)	246 (28.9%)	1.3	<0.0001
Cesarean delivery with prior cesarean section	109,750 (11.01%)	307 (36.1%)	2.8	<0.0001
Plurality				
Singleton	958,486 (95.89%)	781 (91.5%)	0.8	<0.0001
Twins	37,165 (3.72%)	56 (6.6%)	1.5	<0.0001
Triplets	3,047 (0.30%)	16 (1.9%)	5.2	<0.0001
Placenta previa				
Yes	4,254 (0.42%)	152 (18%)	34.5	<0.0001
No	986,888 (99.49%)	694 (82%)	0.7	<0.0001

[a] Multiparity is 1–4 pregnancies

[b] Grandmultiparity is 5 or more pregnancies

surgically explore and possibly perform a hysterectomy in patients with postpartum bleeding and a prior cesarean since the risk of uterine rupture is higher in this group. Counselling of patients willing to undergo a VBAC, in particular those desiring childbearing in the future, should address this significant increase in the risk for this serious complication.

Operative vaginal delivery in patients that had not undergone a cesarean in the past did not seem to increase the risk for PH. Although it has been hypothesized that hematomas and perineal lacerations resulting from a delivery by forceps or vacuum could increase the risk, PH was not any more frequent in those patients in our study. This could be attributed to the small number of subjects in

Table 3 Crude and adjusted multiple logistic regression for peripartum hysterectomy in women in NJ from 1997 to 2005

Characteristic	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	*p* value[†]
Method of delivery			
Vaginal delivery with no prior cesarean section	1	1	Reference
Vaginal delivery with prior cesarean section (VBAC)	2.26 (1.50–3.41)	1.85 (1.22–2.80)	0.0038
Operative vaginal delivery with no prior cesarean section	0.83 (0.52–1.30)	0.97 (0.61–1.54)	0.8972
Operative vaginal delivery with prior cesarean section	2.56 (1.21–5.42)	2.10 (0.99–4.46)	0.0540
Cesarean delivery with no prior cesarean section	3.28 (2.75–3.92)	2.20 (1.80–2.69)	<0.0001
Cesarean delivery with prior cesarean section	6.89 (5.83–8.14)	4.51 (3.76–5.40)	<0.0001
Prior c-section	3.55 (3.09–4.08)	<0.0001	
Race			
White non-hispanics	1	1	Reference
Black non-hispanics	1.23 (1.03–1.47)	1.180 (0.99–1.42)	0.0841
Asian non-hispanics	0.79 (0.59–1.05)	0.78 (0.59–1.04)	0.7047
Hispanic	0.93 (0.78–1.10)	0.97 (0.80–1.16)	0.0907
Others	0.59 (0.29–1.19)	0.60 (0.30–1.22)	0.1595
Age			
<16	0.68 (0.21–2.19)	0.55 (0.17–1.80)	0.3309
16–20	1.13 (0.36–3.52)	0.638(0.20–2.00)	0.4427
21–35	1	1	Reference
36–40	2.36 (0.75–7.37)	0.93(0.29–2.98)	0.9145
>40	4.13 (1.29–13.19)	1.35(0.41–4.40)	0.6136
Birthweight (g)			
<2,500	3.22 (2.70–3.83)	1.89 (1.55–2.31)	<0.0001
2,500–3,499	1	1	Reference
3,500–3,999	0.91 (0.77–1.08)	0.98 (0.82–1.16)	0.7974
4,000–4,499	0.89 (0.67–1.18)	0.88 (0.66–1.17)	0.3844
4,500+	1.32 (0.77–2.25)	1.14 (0.67–1.95)	0.6378
Parity			
Nulliparous	0.43 (0.36–0.50)	0.67 (0.55–0.82)	<0.0001
Multiparous[a]	1	1	Reference
Grandmultiparous[b]	1.95 (1.39–2.74)	1.56 (1.08–2.24)	0.0172
Plurality			
Singleton	1	1	Reference
Twins	1.85 (1.41–2.43)	0.76 (0.56–1.04)	0.0824
Triplets	6.45 (3.92–10.59)	2.08 (1.21–3.58)	0.0085
Multiple gestation (combined)		1.06 (0.84–1.34)	0.05837
Placenta previa	50.81 (42.52–60.72)	23.79 (19.43–29.13)	<0.0001
Placenta previa/previous c-section		43.95 (36.70–52.62)	<0.0001

Adjusted for age, race, parity, birth weight and mode of delivery

[†] *p* value for adjusted odds ratio

[a] Multiparity is 1–4 pregnancies

[b] Grandmultiparity is 5 or more pregnancies

this group not providing sufficient power to demonstrate such an effect. The risk was almost double in the group of patients that had previously undergone a cesarean section although still not statistically significant. This effect can be attributed to the history of a previous cesarean section and operative delivery in the index pregnancy is unlikely to be associated with it.

Women that had their first a cesarean delivery in our study population were almost twice as likely to undergo a hysterectomy compared to women who delivered vaginally. This risk has been confirmed by previous studies suggesting that cesarean delivery is associated with peripartum hysterectomy even in patients receiving elective c-section [10]. The causal pathway between cesarean

section and PH in the majority of cases includes the presence of peripartum hemorrhage. In a recent study, 68.5% of patients receiving a hysterectomy during a primary c-section had peripartum hemorrhage listed in the discharge records, while 27.1% had a placenta previa and 15.1% uterine atony [3]. In the case of elective procedures it has been hypothesized that a cesarean section provides ample access to the uterus and makes PH a more attractive option to the obstetrician treating postpartum hemorrhage.

Our study not only confirmed the increased risk in patients with previous c-section but also demonstrated an even higher risk in women with a repeat cesarean delivery in the current pregnancy, in agreement with previous studies by Kwee et al. [11] and Knight et al. [12]. This observation is alarming considering the rapidly increasing rate of cesarean section in the United States. The above finding can be attributed to the increased incidence of disorders of placentation, such as placenta accreta, percreta and placenta previa with increasing number of previous cesarean sections [13]. Indeed, the presence of placenta previa in our study increased the risk of PH 24-fold while previa with previous c-section almost doubled the risk to 44 times that of an uncomplicated pregnancy (Fig. 1). In 2002, Kastner et al. [14] in a study of 48 cases of PH reported placenta accreta as the most common indication for the procedure since it was present in almost half of the study patients. With reports of a tenfold increase in the incidence of disorders of placentation over the past 50 years [15] the incidence of peripartum hysterectomies is expected to rise significantly.

The effect of multiparity to the higher hysterectomy risk could be associated with the presence of several confounding factors, such as an increased risk of placenta previa, prior cesarean deliveries and placenta accreta or percreta. Another explanation would be that a decision to perform a PH is easier in multiparae since they have already had children and are generally older. Postpartum hemorrhage not amenable to medical treatment has been the lead indication to perform a postpartum hysterectomy in the past.

This study also reports a higher incidence of PH in patients with higher order multiple gestation. Uterine distention from the presence of more than one fetus can result in uterine atony and hemorrhage. Also, the increased incidence of preterm labor in multiple gestations requires the use of tocolytic agents that could contribute to uterine atony. Similar findings have been reported in recent studies by Francois et al. [16] as well as Whiteman et al. [3] On the other hand, a population-based case–control study by Bodelon et al. did not confirm this risk. With a high rate of multiple gestations after in vitro fertilization techniques, more data will be available in the future to confirm or refute this observation.

A limitation of our study remains the validity of the data included in the database. Identification of peripartum hysterectomy cases depended on ICD-10 coding and as result proper documentation was fundamental in this population-based study. The quality of data in any database is dependent on the diligence during data extraction as well as the completeness of the medical records. The risk of inaccurate, incomplete or erroneous documentation in medical records is always present. Despite this, the linkage between birth, death certificates and hospital discharge records in this analysis improves the accuracy of the

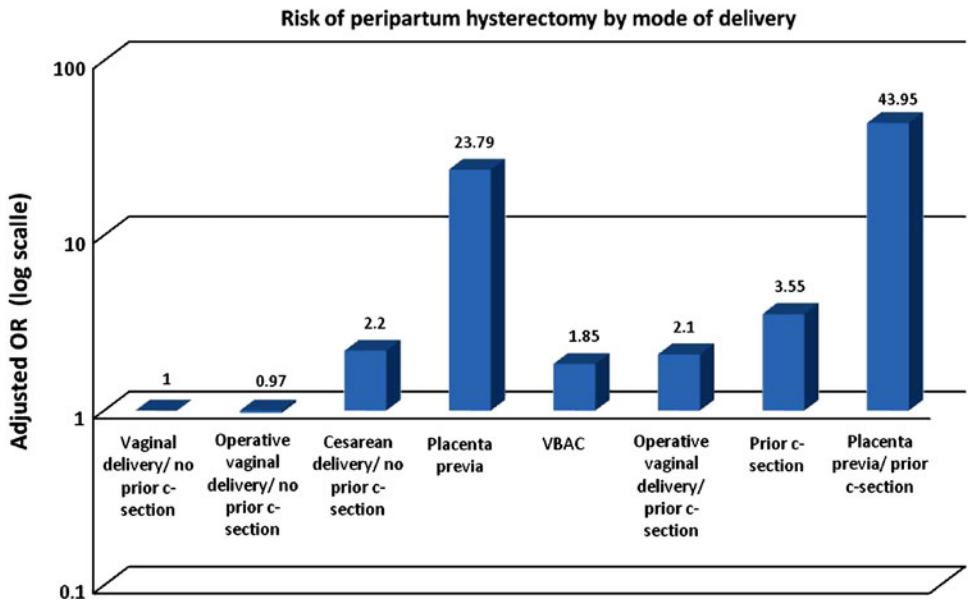

Fig. 1 Risk of peripartum hysterectomy by mode of delivery and prior obstetric history

reported data. In addition, there are several diagnoses for which ICD-10 codes are not specific and could affect the quality of the database. Our analysis is also limited by the inability to specify the indication for the peripartum hysterectomy and whether it was performed in an elective or emergent fashion. A comprehensive chart review would be needed to answer those questions. A review of medical records would decrease the false-positive rate by identifying cases that are erroneously classified as peripartum hysterectomies. Nevertheless, it would not affect the false-negative rate since the identification of cases that were not reported would be technically difficult because of the large amount of records in the database.

This analysis is the second largest in the literature in sample size to report a population-based calculation of the incidence rate of hysterectomies before or immediately after delivery. The greatest strength of this study is inclusion of all deliveries in a defined geographic area over a decade thereby excluding the effect of type of hospital, individual patient or physician characteristics. It is known that patient characteristics and practice patterns of individual physicians lead to inaccuracy in the calculated incidence rate. A previous study has shown a higher rate of PH in large teaching hospitals since they manage most of the complicated pregnancies.[3] This effect is evident in the majority of published studies shown in Table 1 that were based on smaller samples and study periods. The use of record linkage between birth certificates and hospital discharge records improves the validity of information in the database. Also, this is one of the few studies to specifically address the risk of PH in a patient with placenta previa undergoing a cesarean section.

In conclusion, the findings of this study emphasize the importance of mode of delivery and prior obstetric history as a risk factor for peripartum hysterectomy. Considering the significant morbidity and mortality associated with this serious pregnancy outcome, the findings of this and similar studies should be taken into account when counseling patients who undergo primary or repeat cesarean deliveries. In addition, the classification of patients as high or low risk according to the recognized risk factors can assist in the implementation of preventative measures. These could include blood availability for a possible transfusion, ensuring that experienced attendants are present if needed as well as more invasive techniques such as preoperative placement of uterine artery catheters to minimize blood loss or use of intrauterine balloon to tamponade uterine bleeding. There is a large volume of literature indicating the safety of elective cesarean delivery in the short term; however, there is paucity of data in terms of remote complications. Patients undergoing cesarean delivery need to be counseled on remote complications such as abnormal placentation and risk of hysterectomy in subsequent pregnancies.

Conflict of interest statement We declare that we have no conflict of interest.

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