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Emergency obstetric hysterectomy for life-threatening postpartum hemorrhage

A 12-year review

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Abstract

The aim of the study was to review the operative experiences of emergency hysterectomy for life-threatening postpartum hemorrhage (PPH) performed over a 12-year period at Fujian Provincial Maternity and Children's Hospital; to examine the incidence and risk factors for emergency obstetric hysterectomy; and to evaluate the curative effectiveness and safety of subtotal hysterectomy for life-threatening PPH.

The records of all cases of emergency obstetric hysterectomy performed at Fujian Maternity and Children Health Hospital between January 2004 and June 2016 were analyzed. The incidence, risk factors, and outcomes of hysterectomy, the peripartum complications, and the coagulation function indices were evaluated.

A total of 152,023 of women were delivered. The incidence of emergency postpartum hysterectomy was 0.63 per 1000 deliveries: 96 patients underwent hysterectomy for uncontrolled PPH, 19 (0.207‰) underwent hysterectomy following vaginal delivery, and 77 (1.28‰) underwent the procedure following cesarean delivery ($P < .001$). Common risk factors included postpartum prothrombin activity $\leq 50\%$ (61.5%), placenta accreta (43.76%), uterine atony (37.5%), uterine rupture (17.5%), and grand multiparity > 6 (32.3%). Forty-one patients underwent subtotal abdominal hysterectomy (STH) and 55 patients underwent total abdominal hysterectomy (TH). The mean operation time was significantly shorter for TH (193.59 ± 83.41 minutes) than for STH (142.86 ± 78.32 minutes; $P = .002$). The mean blood loss was significantly greater for TH (6832 ± 787 mL) than for STH (6329 ± 893 mL; $P = .003$). The mean number of red cell units transfusion was higher during TH (16.24 ± 9.48 units vs 12.43 ± 7.2, respectively; $P = .047$). Postoperative prothrombin activity was significantly higher than preoperative levels (56.84 ± 14.74 vs 44.39 ± 15.69, respectively; $P < .001$) in women who underwent TH and in those who underwent STH (57.63 ± 15.68 vs 47.87 ± 12.86, respectively; $P < .001$). There was no significant difference in the maternal complications after TH or STH for PPH.

Cesarean deliveries were associated with an increased risk of emergency hysterectomy, and postpartum prothrombin activity $< 50\%$ was the greatest risk factor for hysterectomy in most women who underwent hysterectomy. STH was the preferred procedure for emergency obstetric hysterectomy.

Abbreviations: CS = cesarean section, DIC = disseminated intravascular coagulopathy, ICU = intensive care unit, PPH = postpartum hemorrhage, STH = subtotal hysterectomy.

Keywords: postpartum hemorrhage, subtotal hysterectomy, total hysterectomy

1. Introduction

Severe postpartum hemorrhage (PPH) is a major cause of maternal mortality and morbidity,[1,2] and is increasing in incidence worldwide.[3,4] Hemorrhage is the cause of 12% to 18% of deaths during pregnancy,[5–7] and emergency hysterectomy is increasingly performed to treat uncontrollable PPH. In the first caesarean subtotal hysterectomy (STH), performed by

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Horatio Storer in 1868, the patient survived for only 78 h after the surgical procedure. It was not until 1876 that the first successful operation was performed by Eduardo Porri.[8] Emergency hysterectomy remains a significant practice in modern obstetrics because the technique can save women with major PPH from certain death. However, the surgery is by nature unplanned and performed expeditiously. According to recent reports, 0.20 to 5.09 of every 1000 postnatal women across the globe have undergone an emergency hysterectomy.[9]

Uterine atony and uterine rupture were formerly regarded as the commonest indications necessitating emergency hysterectomy. However, more recent reports have listed placenta accreta as the most common indication,[9,12] and have probably contributed to the growing numbers of cesarean deliveries performed over the last 20 years. Of the numerous studies conducted to examine the indications, predisposing factors, and mortality associated with emergency hysterectomy, some have shown that STH is commonly performed because it is technically easier and requires less operative time, resulting in less blood loss and fewer postoperative complications. However, other studies have found no significant differences in terms of operative time, blood transfusion requirements, intensive care unit (ICU) admission, re-exploration, or the duration of hospital stay between STH and total abdominal hysterectomy (TH). It is important to note that no consensus has been reached on whether STH controls hemorrhage as effectively as TH.

Against this background, the aim of the present study was to examine the incidence and risk factors for emergency obstetric hysterectomy, and to evaluate the curative effectiveness and safety of STH for life-threatening PPH.

2. Methods

2.1. Patients and outcomes

All women who underwent hysterectomy procedures for PPH at Fujian Provincial Maternity and Children's Hospital between January 2004 and June 2016 were included in this retrospectively descriptive study. The study was legally approved by our Institutional Ethics Committee, and the rights of the all the participants were protected.

Emergency hysterectomy was defined as surgery performed at the time or within 24 hours of a vaginal or abdominal delivery, for the treatment of hemorrhage that was unresponsive to conservative approaches. Emergency hysterectomy was only performed when medical or minor surgical procedures (e.g., bimanual uterine compression, administration of oxytocin or prostaglandins, uterine packing, compression sutures such as the B-Lynch brace suture, or other measures) had failed to control PPH. Women delivering before 24 weeks of gestation, and those undergoing emergency hysterectomy performed for gynecological reasons (e.g., sterilization or cancer) or elective cesarean hysterectomy for obstetric reasons were excluded.

We reviewed the records of 96 women who had undergone emergency hysterectomy during the study period, and recorded the following: the maternal and delivery characteristics of each patient, including age (years), gravidity, parity, previous abortion history, previous cesarean section (CS), gestational age (weeks), fetal position, mode of delivery, and indications for cesarean delivery; the measures implemented to prevent hysterectomy and the timing of the hysterectomy, including curettage, ligation of the hypogastric arteries, ligation of the uterine arteries, uterine tamponade, B-Lynch procedure, Bakri balloon, timing of hysterectomy, primary cesarean hysterectomy, relaparotomy post-CS, and laparotomy after vaginal delivery; the clinical results and maternal complications, including operating time (minutes), postoperative hospital stay (days), ICU stay (days), red blood cell transfusion (units), and blood loss (milliliter). Complications, including urinary system injury, pelvic hematoma, wound infection, disseminated intravascular coagulopathy (DIC), acute renal insufficiency, re-exploration after intra-abdominal bleeding, pneumonia, cardiac ischemia, neonatal death, and maternal death. The records of patients treated with TH or STH over the 12-year study period were also compared to identify the factors affecting the choice of surgical technique.

Table 1

Hysterectomy: the incidence of hysterectomy according to mode of delivery.

	Deliveries	Emergency hysterectomies (‰)
Total	152,023	96 (0.63)
Vaginal delivery	91,948	19 (0.207)
Vaginal delivery with no CS	90,362	15 (0.166)
Vaginal birth after cesarean	1,586	4 (2.52)
Cesarean delivery	60,075	77 (1.28)
Cesarean delivery with no CS	45,304	34 (0.75)
Cesarean delivery with prior CS	14,771	43 (2.91)
Cesarean delivery with placenta previa	2,160	46 (21.3)

2.2. Statistical analysis

SPSS 19.0 (SPSS Inc., Chicago, IL) was used to perform the statistical analysis. Continuous data are presented here as means ± standard deviation (SD), and patient parameters (age, operating time, etc.) were analyzed with an independent t test or nonparametric tests (Kruskal–Wallis). Dichotomous data are presented as case (percentage, %), and patient parameters (sex, the range of age, etc.) were compared between 2 groups by using χ^2 tests or nonparametric tests (Fisher exact tests). The results were considered statistically significant if $P < .05$.

3. Results

Of the 152,023 deliveries at Fujian Provincial Maternity and Children's Hospital between January 2004 and June 2016, 96 women (0.063% of all deliveries) underwent emergency hysterectomy. Of these, 19 (0.207‰) underwent hysterectomy following vaginal delivery and 77 (1.28‰) underwent the procedure following a cesarean delivery ($P < .001$). Table 1 shows the incidence of emergency hysterectomy according to the mode of delivery. TH was performed significantly more frequently than STH in women who had a cesarean delivery with previous CS ($P = .004$). There were no significant differences between TH and STH in terms of maternal or delivery characteristics. The mean maternal age was 31.47 ± 4.80 years, mean gestational age was 35.47 ± 4.29 weeks, and median gravidity was 3.29 ± 1.57. There was no significant difference between the TH and STH groups in the surgical procedures used to prevent hysterectomy. The maternal and delivery characteristics and the surgical measures taken to prevent hysterectomy in the TH and STH groups are listed in Table 2.

The common risk factors for emergency obstetric hysterectomy to treat PPH were classified as follows: prothrombin activity (≤50%), placenta accreta, previous uterine curettage, uterine

Table 2

Maternal, delivery characteristics and measures to prevent hysterectomy of cases of emergency obstetric hysterectomy.

	TAH (41)	STH (55)	*P*
Age (y)	31.75 ± 4.67	31.07 ± 4.80	.49
18-25	4	4	.66
25-35	25	33	.92
≥35	12	18	.72
Gravidity	3.66 ± 1.54	3.29 ± 1.63	.26
Parity	1.22 ± 0.79	0.95 ± 0.80	.10
Prior abortion	1.51 ± 1.45	1.39 ± 1.30	.68
Previous CS	27	20	.004
1	23	20	.054
2	4	0	.018
Gestational age (wk)	34.87 ± 5.14	35.51 ± 3.75	.50
Fetal position			
Vertex	28	40	.64
Breech	9	8	.35
Transverse	4	7	.65
Mode of delivery			
Vaginal delivery	11	8	.14
Vaginal delivery with prior CS	2	2	.76
Cesarean delivery	30	47	.14
Cesarean delivery with no prior CS	6	28	.001
Cesarean delivery with prior CS	24	19	.001
Cesarean delivery indications			
Placenta previa and prior CS	23	14	<.001
Placenta previa and no prior CS	2	7	.21
Previous CS alone	2	2	.76
Placental abruption with no previous CS	0	1	.62
Placental abruption with previous CS	1	4	.31
Fetal distress	3	5	.76
Cephalopelvic disproportion	1	2	.74
Breech position	3	6	.55
Measures to prevent hysterectomy			
Curetage	0	2	.39
Tamponade of the uterus	12	22	.28
Ligation Internal iliac artery	0	1	.62
Ligation uterine arteries	5	7	.94
B-Lynch procedure	2	7	.21
Bacri ballon	5	6	.84

STH = subtotal hysterectomy, TAH = total hysterectomy.

atony, grand multiparity >6, and uterine rupture. The greatest risk factor for emergency obstetric hysterectomy was postpartum prothrombin activity ≤50% (n = 59, 61.5%), followed by placenta accreta (n = 51, 53.1%), previous uterine curettage (n = 39, 40.6%), uterine atony (n = 36, 37.5%), grand multiparity >6 (n = 31, 32.3%), and uterine rupture (n = 18, 17.5%). Placental bladder invasion was more prevalent in women who underwent TH than in women who underwent STH (5 [12.2%] vs 0 [0%], respectively). The risk factors for emergency hysterectomy are stratified in Table 3.

Table 4 presents in detail the clinical parameters related to emergency hysterectomy. Forty-one patients underwent STH and 55 patients underwent TH. The mean operation time was significantly less for STH procedures than for TH procedures (142.86 ± 78.32 minutes vs 193.59 ± 83.41 minutes, respectively; $P = .002$). Mean blood loss was significantly higher in the TH group than in the STH group (6832 ± 787 mL vs 6329 ± 893 mL, respectively; $P = .003$). All women required a blood transfusion, and the women who underwent TH required a greater volume than those who underwent STH (16.24 ± 9.48 vs 12.43 ± 7.2 red cell units, respectively; $P = .047$). The hemoglobin levels in

Table 3

Risk factors for emergency obstetric hysterectomy.

Risk factors	Total (%)
Prothrombin activity	
≤50%	59 (61.5)
>50%	37 (38.5)
Placenta accreta	
Yes	51 (53.1)
With placenta previa	42 (43.76)
Without placenta previa	9 (9.375)
Invasion of bladder	5 (5.21)
No	45 (46.9)
Uterine atony	
Yes	36 (37.5)
Uterine atony after CS	29 (30.2)
Uterine atony after vaginal delivery	7 (7.3)
Uterine atony due to placental abruption	5 (5.21)
Uterine atony due to myoma utery	2 (2.1)
No	60 (62.5)
Uterine rupture	
Yes	18 (17.5)
Ruptured uterus with placenta previa	2 (2.1)
No	78 (82.5)
Grand multiparty >6	
Yes	31 (32.3)
No	65 (67.7)
Prior uterine curettage	
Yes	39 (40.6)
No	57 (59.4)

STH = subtotal hysterectomy, TH = total hysterectomy.

women who underwent STH or TH did not differ significantly at the preoperative or postoperative time points. Likewise, no statistically significant differences in prothrombin activity were detected between the women undergoing STH or TH; however, postoperative prothrombin activity was significantly higher than the preoperative level in women who underwent TH (56.84 ± 14.74 vs 44.39 ± 15.69, respectively; $P < .001$) and in those who underwent STH (57.63 ± 15.68 vs 47.87 ± 12.86, respectively; $P < .001$). There was also no statistically significant difference between the STH and TH groups in terms of the duration of their postoperative hospital stay or their ICU admission rate.

The prevalence of maternal morbidity and mortality is shown in Table 5. The overall morbidity rate was 43.75% (42/96). The commonest complication was DIC (n = 36, 37.5%). The

Table 4

Clinical results for emergency obstetric hysterectomy.

	Total hysterectomy (41)	Subtotal hysterectomy (55)	*P*
Operating time (min)	193.59 ± 83.41	142 ± 78.32	.002
Postoperative hospital stay (d)	14.39 ± 11.45	12.68 ± 8.51	.87
Intensive care unit (d)	2.07 ± 1.19	1.83 ± 1.12	.32
Blood loss (mL)	6832 ± 787	6329 ± 893	.003
Red blood cell transfusion (U)	16.24 ± 9.48	12.43 ± 7.2	.047
Hemoglobin (g/dL)			
Preoperative	6.42 ± 1.37	6.19 ± 1.77	.47
Postoperative	6.13 ± 1.89	6.01 ± 1.98	.76
Prothrombin activity			
Preoperative	44.39 ± 15.69	47.87 ± 12.86	.25
Postoperative	56.84 ± 14.74	57.63 ± 15.68	.36

STH = subtotal hysterectomy, TAH = total hysterectomy.

Table 5

Complications for total hysterectomy versus subtotal hysterectomy.

	Total (96)	Total hysterectomy (41)	Subtotal hysterectomy (55)	*P*
Total complications	42	19	23	.66
Urinary system injury	7	5	2	.13
Pelvic hematoma	5	2	3	.90
Wound infection	9	4	5	.91
Disseminated intravascular coagulopathy (DIC)	36	16	20	.79
Acute renal insufficiency	5	1	4	.31
Re-exploration after intraabdominal bleeding	3	1	2	.74
Pneumonia	2	1	1	.83
Cardiac ischemia	2	2	0	.21
Mortality rate	2	0	2	.39

STH = subtotal hysterectomy, TAH = total hysterectomy.

other morbidities, in the order of frequency, were wound infection (n = 9, 9.38%), urinary system injury (n = 7, 7.3%), pelvic hematoma (n = 5, 5.21%), acute renal insufficiency (n = 5, 5.21%), re-exploration after intra-abdominal bleeding (n = 3, 3.13%), pneumonia (n = 2, 2.1%), cardiac ischemia (n = 2, 2.1%), and neonatal death (n = 2, 2.1%). However, there were no statistically significant differences in the incidence of maternal complications between the STH and TH procedures.

4. Discussion

There is considerable variability in the incidence of PPH-related hysterectomy in different countries and even among institutions.[12–15] The overall incidence at our hospital was 0.63 per 1000 deliveries (0.207 per 1000 vaginal deliveries and 1.28 per 1000 CS deliveries). Previous studies have indicated that women who have undergone a previous CS are at higher risk of hysterectomy for PPH than women who have had only vaginal deliveries.[10–13] We also found this to be the case for women admitted to our hospital, where the incidence of hysterectomy for PPH was higher among women with previous CS and placenta previa. Our data show that the incidence of PPH-related hysterectomy was 15 times higher in women who delivered vaginally and who had previously undergone CS than in women who delivered vaginally without a previous CS. Similarly, the incidence of PPH-related hysterectomy for women delivering by CS was 3.87 times higher in those who had previously undergone CS than in those with no previous CS, and was 28 times higher for women with placenta previa delivering by CS. However, there was no significant difference in the incidence of hysterectomy between women with a previous CS delivering vaginally or by CS. The increase in the number of CSs performed has caused an increase in abnormal placentation, placenta previa, and uterine scarring.[8,14–16]

A postpartum prothrombin activity <50% was associated with the need for an additional interventional procedure to stop bleeding despite hysterectomy, and in our study, a postpartum prothrombin activity <50% was the greatest risk factor for hysterectomy in patients with life-threatening PPH, and was observed in most women who underwent hysterectomy. Placenta accreta, previous uterine curettage, uterine atony, grand multiparity >6, and uterine rupture were also risk factors for hysterectomy in patients with life-threatening PPH, and this result is consistent with recent published case series.[12–15] Interestingly, percreta and bladder invasion were more frequent in the TH group than in the STH group. TH presents a reasonable treatment option for severe PPH caused by bladder invasion.

STH was the most commonly performed surgical procedure in the postpartum emergency dataset examined here. This finding is consistent with the findings of other studies.[12–15] We found that STH was more beneficial, in terms of operating time and blood loss reduction, than TH in critically ill women undergoing an emergency procedure. The women who underwent TH required transfusion with a larger volume of red blood cells, but there were no statistically significant differences between TH and STH in terms of the incidence of bladder injury, pelvic hematoma, wound infection, DIC, acute renal insufficiency, intra-abdominal bleeding, pneumonia, cardiac ischemia, neonatal death, or maternal death.

A previous study reported that the rate of ureteric injury from surgery was higher in women undergoing TH than in those undergoing STH. In the present study, the complication rate was 7.3% for both groups, which lies within the previously reported range of 4% to 15%.[13,17–19] We consider that the vesicouterine scarring caused by previous CS procedures increases the risk of bladder injury, which explains the higher rate of bladder injury in women who underwent hysterectomy with placenta accreta than in those who underwent hysterectomy for uterine atony. However, the bladder injury rate did not differ between STH and TH for women with these conditions, despite the fact that previous studies have reported elevated rates of bladder injury after TH and placenta accreta.[21] In the present study, 37.9% of women developed DIC. Although maternal care and ICU facility conditions improved over the study period, the DIC rate remained similar for TH and STH (39.0% vs 36.4%, $P = .79$, respectively). The DIC incidence rates in our study were higher than those observed in other studies,[20,21] which may be related to the highly conservative approach taken at our hospital to prevent emergency obstetric hysterectomy. In this study, the incidence of re-exploration after hysterectomy for PPH reported here (3.125%) is lower than the reported range of 4% to 25%.[13,18–19,26] Re-exploration was more common after STH than after TH, but the difference was not statistically significant (2.44% vs 3.64%, $P = .74$, respectively). Wright et al[19] and Gungorduk et al[17] reported higher re-exploration rates after STH, but Ozden et al[13] reported higher re-exploration rates after TH. The maternal mortality rate reported here (2.1%) is lower than the previously reported range (11.8%–31.0%).[22–25] It has been reported that coagulopathy control is imperative for a successful hysterectomy for PPH.[26–27] Our detailed preoperative and postoperative coagulation function index data for PPH-related hysterectomy revealed that postoperative prothrombin activity increased significantly relative to the midoperation levels in all the women analyzed, except 3 who underwent re-

exploration after intra-abdominal bleeding and 2 women who died. In 69 women, conservative measures failed to prevent hysterectomy, resulting in reduced prothrombin activity until the blood loss was adequately controlled. In the women who underwent re-exploration and in those who died, prothrombin activity decreased steadily before re-exploration. Therefore, this trend in prothrombin activity can be considered a marker of blood loss. Blood loss is usually monitored using hemoglobin levels, but it is difficult to identify blood loss during an ongoing blood transfusion by examining hemoglobin. Therefore, it is auspicious that prothrombin activity can be used as a marker for blood loss. Prothrombin activity <50% is a cause for alarm, and if the prothrombin activity continues to decline, it is reasonable to assume that conservative measures have failed to control blood loss, and preparations for hysterectomy for PPH should be initiated. Further reductions in prothrombin activity after a hysterectomy indicate that the hemorrhage has not been effectively controlled.

The major limitation of this study was its retrospective design. The study was also limited in that the data collected were from a single institution. Furthermore, the measures taken to avoid hysterectomy for PPH may have affected the results. Among kinds of measures, fibrinogen concentrate, cryoprecipitates, and tranexamic acid that used to handle the situation of coagulopathy would affect the incidence of bleeding as well as life-threatening PPH, and to some extent of the incidence of emergency hysterectomy. Thus, it would be very practical to investigate whether monitoring coagulopathy and corresponding effective treatment would be helpful to avoid and decrease the incidence of emergency hysterectomy in the future,

We have conducted a comprehensive overview of hysterectomy for PPH during a 12-year follow-up period. Caesarian deliveries entail a greater risk of hysterectomy for PPH than vaginal deliveries. Postpartum prothrombin activity <50% was found to be the greatest risk factor for hysterectomy, and occurred in most women who underwent hysterectomy. Our comparison of the data for women undergoing TH and STH procedures for PPH provides a basis for the future selection of the type of hysterectomy procedure to be used. In this study, STH was the preferred procedure for hysterectomy for PPH.

References

[1] Callaghan WM, Kuklina EV, Berg CJ. Trends in postpartum hemorrhage: United States, 1994–2006. Am J Obstet Gynecol 2010; 202: 353 e 1-6.

[2] Say L, Chou D, Gemmill A, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health 2014;2:e323–33.

[3] Mehrabadi A, Hutcheon JA, Lee L, et al. Epidemiological investigation of a temporal increase in atonic postpartum haemorrhage: a population-based retrospective cohort study. BJOG 2013;120:853–62.

[4] Kramer MS, Berg C, Abenhaim H, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol 2013;209: 449 e 1-7.

[5] Clark SL, Belfort MA, Dildy GA, et al. Maternal death in the 21st century: causes, prevention, and relationship to cesarean delivery. Am J Obstet Gynecol 2008;199:36 e1–5.

[6] Creanga AA, Berg CJ, Syverson C, et al. Pregnancy-related mortality in the United States, 2006–2010. Obstet Gynecol 2015;125:5–12.

[7] Saucedo M, Deneux-Tharaux C, Bouvier-Colle MH. Ten years of confidential inquiries into maternal deaths in France, 1998–2007. Obstet Gynecol 2013;122:752–60.

[8] Sturdee DW, Rushton DI. Caesarean and post-partum hysterectomy 1968–1983. Br J Obstet Gynaecol 1986;93:270–4.

[9] de la Cruz CZ, Thompson EL, O'Rourke K, et al. Cesarean section and the risk of emergency peripartum hysterectomy in high-income countries: a systematic review. Arch Gynecol Obstet 2015;292:1201–15.

[10] Flood KM, Said S, Geary M, et al. Changing trends in peripartum hysterectomy over the last 4 decades. Am J Obstet Gynecol 2009;200: 632 e1–6.

[11] Forna F, Miles AM, Jamieson DJ. Emergency peripartum hysterectomy: a comparison of cesarean and postpartum hysterectomy. Am J Obstet Gynecol 2004;190:1440–4.

[12] Demirci O, Tugrul AS, Yilmaz E, et al. Emergency peripartum hysterectomy in a tertiary obstetric center: nine years evaluation. J Obstet Gynaecol Res 2011;37:1054–60.

[13] Ozden S, Yildirim G, Basaran T, et al. Analysis of 59 cases of emergent peripartum hysterectomies during a 13-year period. Arch Gynecol Obstet 2005;271:363–7.

[14] Kwee A, Bots ML, Visser GH, et al. Emergency peripartum hysterectomy: a prospective study in The Netherlands. Eur J Obstet Gynecol Reprod Biol 2006;124:187–92.

[15] Bateman BT, Mhyre JM, Callaghan WM, et al. Peripartum hysterectomy in the United States: nationwide 14 year experience. Am J Obstet Gynecol 2012;206:63 e1–8.

[16] Belfort MA. Placenta accreta. Am J Obstet Gynecol 2010;203:430–9.

[17] Gungorduk K, Yildirim G, Dugan N, et al. Peripartum hysterectomy in Turkey: a case-control study. J Obstet Gynaecol 2009;29:722–8.

[18] Yalinkaya A, Guzel AI, Kangal K. Emergency peripartum hysterectomy: 16-year experience of a medical hospital. J Chin Med Assoc 2010;73: 360–3.

[19] Wright JD, Devine P, Shah M, et al. Morbidity and mortality of peripartum hysterectomy. Obstet Gynecol 2010;115:1187–93.

[20] Stanco LM, Schrimmer DB, Paul RH, et al. Emergency peripartum hysterectomy and associated risk factors. Am J Obstet Gynecol 1993;168 (3 Pt. 1):879–83.

[21] Lau WC, Fung HY, Rogers MS. Ten years experience of caesarean and postpartum hysterectomy in a teaching hospital in Hong Kong. Eur J Obstet Gynecol Reprod Biol 1997;74:133–7.

[22] Omole-Ohonsi A, Olayinka HT. Emergency peripartum hysterectomy in a developing country. J Obstet Gynaecol Can 2012;34:954–60.

[23] Obiechina NJ, Eleje GU, Ezebialu IU, et al. Emergency peripartum hysterectomy in Nnewi, Nigeria: a 10-year review. Niger J Clin Pract 2012;15:168–71.

[24] Abasiattai AM, Umoiyoho AJ, Utuk NM, et al. Emergency peripartum hysterectomy in a tertiary hospital in southern Nigeria. Pan Afr Med J 2013;15:60.

[25] Akintayo AA, Olagbuji BN, Aderoba AK, et al. Emergency peripartum hysterectomy: a multicenter study of incidence, indications and outcomes in Southwestern Nigeria. Matern Child Health J 2016; 20:1230–6.

[26] Zorlu CG, Turan C, Isik AZ, et al. Emergency hysterectomy in modern obstetric practice. Changing clinical perspective in time. Acta Obstet Gynecol Scand 1998;77:186–90.

[27] Michelet D, Ricbourg A, Gosme C, et al. Emergency hysterectomy for life-threatening postpartum haemorrhage: risk factors and psychological impact. Gynecol Obstet Fertil 2015;43:773–9.