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Safe motherhood : severe maternal morbidity in the Netherlands. The LEMMoN study

Zwart, J.J.

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CHAPTER 8

Peripartum hysterectomy and arterial embolization for major obstetrical hemorrhage: a two-year nationwide cohort study in the Netherlands

Zwart JJ, Dijk PD, van Roosmalen J.

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Abstract

Objective: To assess incidence, case fatality rates and risk factors of peripartum hysterectomy and arterial embolization for major obstetric haemorrhage.

Study design: Two-year prospective nationwide population-based cohort study. All pregnant women in the Netherlands during the same period acted as reference cohort (n=371,021)

Results: We included 205 women, overall incidence being 5.7 per 10,000 deliveries. Arterial embolization was performed in 114 women (incidence 3.2 per 10,000; case fatality rate 2.0%). Peripartum hysterectomy was performed in 108 women (incidence 3.0 per 10,000; case fatality rate 1.9%). Seventeen women had hysterectomy after embolization had failed to control haemorrhage. Caesarean delivery (RR 6.6; 95% CI 5.0-8.7) and multiple pregnancy (RR 6.6; 95% CI 4.2-10.4) were the most important risk factors in univariable analysis.

Conclusion: The rate of obstetric haemorrhage necessitating hysterectomy or arterial embolization in the Netherlands is 5.7 per 10,000 deliveries, with fertility being preserved in 46% of women by successful arterial embolization.

Introduction

Major obstetrical haemorrhage is the most frequent cause of severe acute maternal morbidity worldwide. Although maternal death due to haemorrhage is rare in Western countries, major obstetrical haemorrhage can lead to severe long-term sequelae and saving the mother's life sometimes demands the maximum of available resources. In the Netherlands, major obstetrical haemorrhage is responsible for 49% of obstetric admissions to intensive care units.¹ Recent studies demonstrate an increase of severe maternal morbidity related to major obstetrical haemorrhage in Western countries.²⁻⁶ Possible explanations include the increasing age of women at birth, the increasing multiple pregnancy rate as a consequence of artificial reproductive techniques and the increasing caesarean delivery rate.

Since the maternal mortality ratio due to major obstetrical haemorrhage in Western countries is extremely low, and it therefore takes years to collect the numbers needed to be able to draw valid conclusions and learn lessons, severe maternal morbidity from obstetrical haemorrhage has gained interest as a new quality indicator of obstetric care.^{2,7-9} An important indicator would be the number of peripartum hysterectomies or arterial embolisations for major obstetrical haemorrhage. Recently, the United Kingdom Obstetric Surveillance System (UKOSS) reported on the incidence of peripartum hysterectomy in the United Kingdom, which was 4.1 per 10,000 births.¹⁰

When facing major obstetrical haemorrhage that is intractable with conventional therapies, hysterectomy or embolization of the uterine and/or internal iliac arteries can be the last resort. Arterial embolization is increasingly the treatment of choice in these women in order to preserve fertility. A recent study concludes that fertility is not adversely affected by arterial embolization, and that women can conceive with normal pregnancy outcomes.¹¹ However, arterial embolization is not always appropriate, successful or available.

A nationwide cohort study of severe maternal morbidity, called LEMMoN, was conducted in the Netherlands to assess incidence, case fatality rates and risk factors for different types of morbidity, including major obstetrical hemorrhage.¹² Major obstetrical haemorrhage appeared to be the most frequent cause of severe maternal morbidity in the Netherlands, involving 51.1% of all women included. This article describes the most severe cases of major obstetrical haemorrhage from this study: women with peripartum hysterectomy or embolization. The main objectives of this study were firstly to describe the nationwide population-based incidence of arterial embolization and peripartum hysterectomy for obstetrical haemorrhage, and secondly to compare risk factors and outcomes of arterial embolization and peripartum hysterectomy for obstetrical haemorrhage.

Materials and Methods

Women were included from 1 August 2004 until 1 August 2006. All 98 hospitals (100%) with a

maternity unit in the Netherlands participated. Detailed methods were described previously.¹² In each hospital, a local coordinator reported all cases monthly using a standardized web-based form. Absence of cases in a particular month was also communicated to control for underreporting. Cases were identified in the respective hospitals using multiple strategies, including maternity computer databases, labour ward diaries, staff reports, intensive care admission registers, blood transfusion registers, discharge data and personal communication. All women with hysterectomy or arterial embolization due to obstetrical haemorrhage during pregnancy, delivery and puerperium (limited to six weeks postpartum) were included in the current study. Cases of first- or second-trimester instrumental abortion or termination of pregnancy up to 24 weeks were classified as 'early pregnancy'. Women who had hysterectomy after failed arterial embolization were analyzed in the hysterectomy group since hysterectomy was the ultimate treatment that stopped haemorrhage.

We recorded maternal characteristics (age, body mass index, ethnicity, single household and smoking), obstetric history, all data on pregnancy and delivery and specific data on major obstetrical haemorrhage (amount of blood loss, causes, surgical interventions, intensive care unit admission, blood products and medication administered, haemoglobin levels, clotting parameters). Body mass index was calculated using pre-pregnancy weight or weight measured during the first trimester. Cases with a missing value for a specific parameter were excluded when calculating the rate for that variable. We assessed the availability of arterial embolization in the Netherlands through a national survey.

Incidence was calculated using the total number of births in the Netherlands during the study period as the denominator. Denominator data for the number of deliveries in the Netherlands were obtained from Statistics Netherlands (CBS).¹⁴ They were based on birth registries after correction for stillbirths of 24 weeks or over and multiple pregnancies. Relative risks (RR) with 95% confidence intervals (CI) and absolute risks were calculated if national reference data were available. National reference values for possible risk factors were obtained from Statistics Netherlands and the Netherlands Perinatal Registry.¹⁵

Case fatality rates were calculated by dividing the number of deaths after hysterectomy or arterial embolization by the number of cases of hysterectomy or arterial embolization. Cases in the arterial embolization and hysterectomy group were further analyzed by cause of haemorrhage. Although up to three causes could be reported, we classified women according to the most important cause of haemorrhage. We compared women in the current study to the total group of women having experienced major obstetrical haemorrhage in the Netherlands, defined as need for transfusion of four or more units of red blood cells.¹² Statistical analysis was performed using the SPSS statistical package 14.0 (SPSS Inc., Chicago, IL, USA). Approval of the Institutional Review Board was not necessary since all data were collected anonymously.

Results

During the study period, there were 371,021 deliveries in the Netherlands. All 98 hospitals with an obstetric ward in the Netherlands participated (100%). A maximum of 2352 (98 x 24) 'hospital-months' could be reported. Mainly due to later enrolment of some hospitals into the study, a total of 2275 'hospital-months' were actually returned (97%). Regarding only those maternities occurring during the months each hospital actively participated in the study, the study represented 358,874 deliveries.

Table 1. Possible risk factors for hysterectomy/arterial embolization for major obstetric emorrhage

	<i>Hys/emb</i> (<i>n</i> =205)	<i>Netherlands</i> (<i>n</i> =358,874)	<i>RR</i> (95% <i>CI</i>)	<i>Absolute risk</i> (overall 1 in 1751)
Patient				
age ≥ 35	43.4%	24.7% ^a	2.3 (1.8-3.1)	1 in 748
low income	26.7%	n/a		
Single household	3.4%	n/a		
BMI ≥ 25 (overweight)	28.2%	31.7% ^a	0.9 (0.6-1.2)	1 in 2060
BMI ≥ 30 (obese)	10.9%	9.8% ^a	1.1 (0.6-1.9)	1 in 1591
BMI ≥ 35 (morbidly obese)	4.7%	n/a		
non-Western immigrant	24.4%	16.8% ^a	1.6 (1.2-2.2)	1 in 1094
Pregnancy				
initial care by obstetrician	52.7%	14.3% ^a	6.7 (5.1-8.8)	1 in 262
prior caesarean delivery	26.8%	10.1%	3.3 (2.4-4.5)	1 in 529
placenta praevia	10.7%	n/a		
nulliparity	39.5%	45.2% ^a	0.8 (0.6-1.1)	1 in 2216
parity ≥3	7.3%	5.0% ^a	1.5 (0.9-2.5)	1 in 1167
multiple pregnancy	10.2%	1.7% ^a	6.6 (4.2-10.4)	1 in 265
artificial reproduction techniques: IVF/ICSI	9.5%	1.9% ¹⁷	5.4 (3.2-9.0)	1 in 324
Delivery				
induction of labour	29.8%	12.3% ^b	3.1 (2.3-4.2)	1 in 568
caesarean delivery	49.8%	13.0% ^a	6.6 (5.0-8.7)	1 in 264
pre-labour caesarean delivery	23.9%	5.9% ^a	5.0 (3.6-6.9)	1 in 349
ventouse/forceps	11.7%	8.6% ^a	1.4 (0.9-2.2)	1 in 1242
home delivery	3.4%	31.6% ^b	0.1 (0.04-0.2)	1 in 218,826
breech delivery	9.3%	4.9% ^a	2.1 (1.3-3.4)	1 in 834
preterm birth (<37w)	17.8%	5.8% ^b	3.5 (2.5-5.1)	1 in 497
post term birth (≥42w)	4.5%	4.3% ^b	1.0 (0.6-2.1)	1 in 1683

National reference values from ^a Statistics Netherlands (exact study period) and ^bThe Netherlands Perinatal Registry 2005; n/a: not available.

Hysterectomy or arterial embolization for major obstetrical haemorrhage was performed in 205 women (5.7 per 10,000 deliveries). This constituted 12.8% (205/1606) of all cases of major obstetrical haemorrhage reported to LEMMoN. Arterial embolization was performed in 114 women (incidence 3.2 per 10,000 deliveries), in 17 of whom hysterectomy was necessary as yet. Hysterectomy was performed in 108 women (incidence 3.0 per 10,000 deliveries). Four women died, two after embolization, one after hysterectomy and one after both procedures. Overall case fatality rate was 2.0% (4/205). In 95 women (46% of all cases) fertility could be preserved by the availability of arterial embolization.

Possible risk factors for arterial embolization or hysterectomy with reference to national data^{14;15} are shown in table 1, including absolute risks. When comparing these therapies, women older than 35 years had a higher risk of hysterectomy than arterial embolization (RR 1.4, 95%CI 1.1-1.8), whereas nulliparae had a lower risk (RR 0.3, 95%CI 0.2-0.5).

Diagnosis

An overview of the causes of major obstetrical haemorrhage, in both the peripartum hysterectomy and the arterial embolization group, is shown in table 2. In 50% of women, more than one diagnosis was reported, most important combinations being uterine atony with disorders of placentation or placental remnants.

Table 2. Causes of major obstetric haemorrhage^a (n=201^b)

Primary diagnosis	hysterectomy (n=105) (%)	arterial embolization (n=96) (%)
Disorders of placentation ^c	37 (35)	5 (5)
Uterine atony ^d	29 (28)	32 (33)
Uterine rupture	11 (10)	0 (0)
Placental remnants ^d	10 (10)	30 (31)
Iatrogenic during surgery ^e	8 (8)	13 (14)
Genital tract laceration	4 (4)	11 (11)
Blood coagulation disorders	1 (1)	0 (0)
Miscellaneous ^f	4 (4)	4 (4)
Placenta praevia as single diagnosis	1 (1)	1 (1)
Total placenta praevia	15 (14)	7 (7)

^aonly most important cause was considered; ^bfor 4 women no diagnosis available; ^cincludes morbidly adherent placenta (n=25), placenta praevia (n=2) and combination of both (n=12); ^dincludes placenta praevia (n=1); ^eincludes placenta praevia (n=2); ^fincludes placenta praevia (n=2), placental abruption (n=2) and blood coagulation disorders (n=1)

The choice for arterial embolization or hysterectomy depended largely on the cause of major obstetrical haemorrhage. In case of uterine rupture or morbidly adherent placenta, 100 and 88% of women had a hysterectomy respectively. In contrast, in case of uterine atony and retained placenta/placental remnants, only 45 and 25% had a hysterectomy.

Hysterectomy appeared to be strongly associated with placenta praevia and morbidly adherent placenta. Fifteen women (14%) had placenta praevia in the index pregnancy, thirteen of whom (87%) had a morbidly adherent placenta. Nine (60%) had a caesarean delivery in their obstetric history, as was the case for seven (54%) women with a morbidly adherent placenta.

Mode of delivery

In six women haemorrhage occurred in early pregnancy, resulting in embolization in one case after termination of pregnancy at 20 weeks of gestational age. In the remaining five cases, hysterectomy was performed after D&C (n=3), incomplete abortion (n=1) or placenta percreta (n=1). This last case consisted of a hysterectomy performed with the foetus still in utero at 16 weeks of gestational age because of placenta percreta growing into the bladder causing massive intra-abdominal haemorrhage.

In the remaining 199 cases, the overall caesarean delivery rate was 51% (64% and 38% respectively for hysterectomy and arterial embolization, RR 1.7 (95% CI 1.3-2.3).

RRs for hysterectomy or embolization related to mode of delivery are shown in table 1. RR of hysterectomy alone for major obstetrical haemorrhage after caesarean delivery was 3.6 (95% CI 2.5-5.2) as compared with women who had a vaginal delivery.

Other interventions

Different treatment strategies had been used before embolization or hysterectomy were eventually necessary (Table 3). Three women (1%) had no additional therapy at all, of which in one case caesarean hysterectomy was electively performed for placenta praevia. In the second case a woman had a placenta praevia percreta in the scar of a prior caesarean, which could not be removed. In the third case elective caesarean hysterectomy was performed in a woman with beta-thalassemia and placenta praevia. Four women were Jehovah's witnesses and did not receive any blood products at all, which in one case resulted in maternal death.

Figure 1.

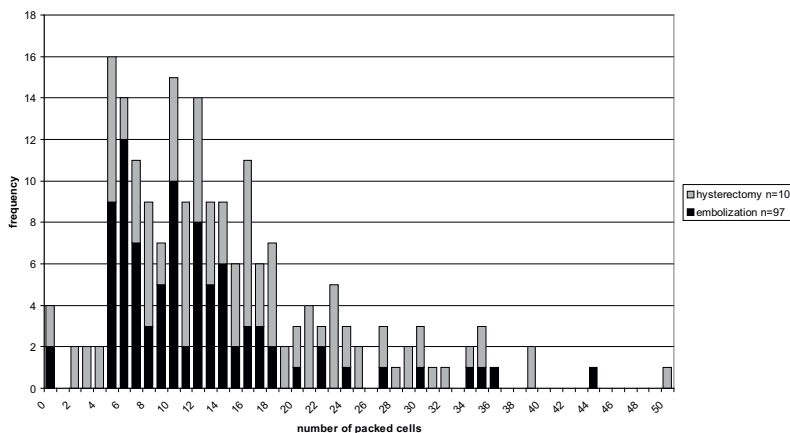


Table 3. Other interventions (n=205)

<i>Therapy</i>	<i>hysterectomy (n=108) n (%)</i>	<i>arterial embolization (n=97) n (%)</i>
Misoprostol	14 (13)	13 (13)
Syntocinon	87 (81)	87 (90)
Methergin	21 (19)	15 (15)
Sulproston	72 (67)	83 (86)
Plasma replacement therapy	86 (80)	75 (77)
Recombinant factor VIIa	19 (18)	14 (14)
Prothrombine complex	1 (1)	2 (2)
Fibrinogen	3 (3)	1 (1)
Red blood cells ^a	105(98)	89 (98)
Eight or more red blood cells ^a	86 (80)	59 (65)
Fresh frozen plasma ^b	90 (89)	86 (95)
Platelets ^b	61(62)	49 (53)
Manual placenta removal	17 (16)	16 (16)
Removal of placental remnants	30 (28)	44 (45)
Balloon therapy	23 (21)	29 (30)
Other surgical interventions ^c	11 (10)	6 (6)

^a data missing for 7 women; ^b data missing for 13 women; ^c ligation of arteries, B-lynch suture, inspection

Blood transfusion requirements of both the arterial embolization and the hysterectomy group are shown in Figure 1. Women undergoing hysterectomy were transfused significantly more units of red blood cells (median 14) than women undergoing arterial embolization (median 10; $p=0.002$). Women in the hysterectomy group needed significantly more often massive transfusion, defined as eight or more units of red blood cells (RR 1.5; 95% CI 1.1-2.1) and were more often admitted to an intensive care unit (RR 1.6; 95% CI 1.1-2.4) as compared with women in the embolization group. Median hospitalization for hysterectomy was 10 days (range 2-65) versus 7 (range 1-38) for embolization.

Details of hysterectomy

An overview of different timing, procedures and complications of hysterectomy is shown in table 4. Sub analysis by primary cause of haemorrhage revealed no significant differences. Of 11 women with urinary tract lesions, eight had damage of the bladder and three of the ureter. Unilateral ovarian removal occurred in eight women (7%). Two women died after hysterectomy (2%). One woman had major obstetrical haemorrhage due to uterine atony after spontaneous vaginal delivery.

She died from cerebral damage caused by hemorrhagic shock. The other woman developed sepsis with intrauterine fetal death at 36 weeks of gestation. She developed postpartum haemorrhage and died from multi-organ failure.

Table 4. Procedure, timing and complications of hysterectomy (n=108)

<i>Procedure</i>	<i>n (%)</i>
Total hysterectomy	40 (37)
Supravaginal hysterectomy	52 (48)
Unknown	16 (15)
<i>Timing</i>	
Hysterectomy after vaginal delivery	41 (38)
Caesarean hysterectomy	29 (27)
Relaparotomy after caesarean	38 (35)
<i>Complications</i>	
Urinary tract lesions ^a	11 (10)
Removal of ovary	8 (7)
Infection ^b	8 (7)
Relaparotomy ^c	15 (14)
Sheehan syndrome	4 (4)
Paralytic ileus	3 (3)
DVT / Pulmonary embolism	3 (3)
Others	2 (2)
Maternal death	2 (2)

^a including eight bladder lesions and three ureter lesions; ^b including two abscesses; ^c including one case of burst abdomen

Details of arterial embolization

Of all 98 obstetrically active hospitals in the Netherlands, 23% reported to have unrestricted availability of arterial embolization 24 hours a day and another 20% reported availability in consultation with the intervention radiologist. During office hours, percentages were 30 and 15, respectively. All tertiary care centres had 24-hour availability of an intervention radiology team.

Methodological details and complications of arterial embolization procedure are shown in table 5. Fifty-nine women (61%) received eight or more units of packed cells (median 10; range 0-44). Intensive care unit admission occurred in 67 women (69%). Of the twelve women developing symptoms and signs of infection after arterial embolization, nine (75%) had had caesarean delivery. In 20 cases (18%), arterial embolization failed. In fifteen cases hysterectomy was necessary as yet to stop haemorrhage. In two cases uterine necrosis occurred resulting in hysterectomy, in one case intrauterine balloon tamponade stopped haemorrhage as yet, and two women died. In three cases the procedure could not be completed due to vasospasms (which terminated the bleeding).

One woman was embolised three times before hysterectomy was performed. During the first attempt both uterine arteries were embolised, followed by embolization and re-embolization of both internal iliac arteries. Failure rate varied by mode of delivery. Of 66 women with arterial embolization following vaginal delivery, 5 (8%) eventually underwent hysterectomy. Of 48 women with embolization after caesarean delivery, 12 (25%) eventually underwent hysterectomy (RR 1.9; 95% CI 1.3-2.8). Thirteen out of 20 women with failed embolization (65%) had one or more deliveries in obstetric history.

Table 5. Procedure and complications of embolisation (n=114)

<i>Procedure</i>	<i>n (%)</i>
Uterine artery (42 bilateral, 3 left, 8 right)	53 (46)
Internal iliac artery (23 bilateral, 1 left)	24 (21)
Combination of iliac and uterine artery	3 (3)
Hepatic artery	1 (1)
Unknown	33 (29)
<i>Complication of Embolization</i>	
Hysterectomy	17 (15)
Infection (9 after caesarean delivery)	9 (8)
ARDS	1 (1)
Laparotomy	3 (3)
Ischemic complaints	2 (2)
Maternal death	3 (3)

Comment

The LEMMoN study includes the first nationwide survey of major obstetrical haemorrhage in the Netherlands, comprising of 1606 cases (4.5 per 1000 deliveries).⁹ In this article, the severest cases of major obstetrical haemorrhage, ultimately leading to arterial embolization or hysterectomy, have been mapped. The incidence in our study was 5.7 per 10,000 deliveries, 3.2 per 10,000 for arterial embolization and 3.0 per 10,000 for hysterectomy.

The European Perinatal Health Report (Peristat-II) recently reported nationwide incidence figures of peripartum hysterectomy varying between 2 and 10 per 10,000 deliveries.¹⁹ Although the increasing attention to severe maternal morbidity is welcomed, the figures in this report should be interpreted cautiously as case ascertainment varied greatly between countries and detailed methods of data collection were not reported.

The incidence of hysterectomy for major obstetrical haemorrhage is increasing. A nationwide population-based Canadian study showed an increase of obstetrical haemorrhage necessitating hysterectomy from 2.6 per 10,000 deliveries in 1991-1993 to 4.6 per 10,000 in 1998-2000.³ Further increase was suggested

recently by a regional population-based study from Canada, reporting an incidence of 8 per 10,000 deliveries in 1999-2006.²⁰ A nationwide cross-sectional study in the United States from 1998 to 2005 reported an increase as well.⁶ Additionally, an Australian population-based study reported an overall increase of adverse outcomes in women with postpartum haemorrhage of 14.3% between 1999 and 2004.⁵ Since hysterectomy is one of the severest complications of pregnancy, the necessity to examine differences and increase in incidence cannot be disregarded.

To our knowledge, this study includes the first report of nationwide incidence of arterial embolization in the literature. A factor that might bias the relatively low incidence of peripartum hysterectomy in the Netherlands is the relatively frequent use of arterial embolization, which prevented hysterectomy in half of all cases. We were not able to compare the availability of arterial embolization in the Netherlands with other countries, or with another period. In some countries, the existence of large, separate maternity hospitals hampers general availability of arterial embolization for major obstetrical haemorrhage. Although the low incidence of major obstetrical haemorrhage necessitating arterial embolization alone (about one case a year for an average Dutch obstetric unit) may not warrant the 24 hour availability of an interventional radiology team in every hospital, radiological intervention is also increasingly used in other non-obstetric acute situations and the trend towards centralization of obstetric care in the Netherlands will likely increase availability of arterial embolization over the next few years.

Several studies that aimed to identify risk factors for peripartum hysterectomy showed that caesarean delivery - in the current pregnancy and in the obstetric history - is an important risk factor. We confirmed this finding in this prospective population-based study, relative risk for hysterectomy or arterial embolization in women with a caesarean delivery being 6.6 for caesarean in the index pregnancy and 3.3 for previous caesarean. As the rates of caesarean delivery continue to rise rapidly worldwide, and peripartum hysterectomy most often is a remote complication of caesarean delivery, a further increase of the incidence of peripartum hysterectomy and arterial embolization can be expected. It is therefore of vital importance to identify causes of the increase in caesarean delivery rates. Reduction of these rates will likely prevent many cases of peripartum hysterectomy and arterial embolization.

Other possible risk factors for major obstetrical haemorrhage with subsequent hysterectomy or arterial embolization in this study included advanced maternal age, non-Western ethnic origin, multiple pregnancy, artificial reproduction techniques (resulting in many multiple pregnancies), breech delivery and preterm birth. The higher risk for hysterectomy with advanced maternal age could be explained by the fact that older women generally already have children, and clinicians will be more eager to preserve fertility in young and often nulliparous women. Body mass index appeared not to be a risk factor in this study.

During the study, only one woman who delivered at home required hysterectomy. This validates the proper functioning of selection of low-risk pregnancies in the Netherlands.

In the sub analysis of failed arterial embolization procedures, we found a 25% failure rate for arterial embolization following caesarean delivery. This implicates thorough consideration proceeding to embolization when facing major obstetrical haemorrhage after caesarean. Contrarily, the success rate of arterial embolization was significantly increased in nulliparous women, which has also been found in a trial of arterial embolization versus hysterectomy in the treatment of symptomatic uterine fibroids.¹⁸ No explanation, however, was found for this phenomenon.

Apart from the failure rate and consequently loss of valuable time, there were few negative side-effects of arterial embolization. Indeed, the rate of intensive care unit admission in the arterial embolization group was significantly lower and women received significantly less blood products. These numbers may be biased by the fact that in critical situations the risk of a failing embolization will not be taken, and clinicians will proceed to immediate hysterectomy.

The main limitation of this study is that we did not record the individual characteristics of all maternities without hysterectomy or arterial embolization during the study period. Therefore, we could not adjust RRs for confounding variables. For some associated factors, it is important to realise that the condition could be the cause of severe maternal morbidity, but it could also represent the result of it. This bias by indication especially occurs in case of caesarean delivery, which was regularly performed because of (imminent) obstetrical haemorrhage. Likewise, preterm birth is also closely related. Due to the nationwide nature of the study, we depended on the active participation of local coordinating obstetricians for completeness of data. We tried to meet this by keeping coordinators actively involved and providing help in collecting data. Finally, we thoroughly controlled for underreporting. Underreporting of major obstetrical haemorrhage was estimated at 35% but appeared to be mainly due to relatively less severe complications requiring 'only' four units of red blood cells.²¹ However, no underreporting of cases of hysterectomy or arterial embolization was found.

Fertility has been preserved in 95 women, almost half of all cases. Together with the lower rate of intensive care unit admissions, reduced need for blood products, shorter hospitalization and smaller invasiveness, arterial embolization seems to be an attractive alternative when facing severe, therapy resistant obstetrical haemorrhage. Ideally, these observational findings should be confirmed in a randomized trial but this will unlikely be designed due to ethical considerations. Only individual audit of cases could reveal important disadvantages of arterial embolization. Exact indications and contraindications for arterial embolization remain to be determined in future research. However, in face of the increasing number of caesareans worldwide, further distribution of knowledge and skills of embolization is necessary. Additionally, causes of this increase should be identified, in order to reduce the caesarean rate. This may lead to reduction of the incidence of major obstetrical haemorrhage, along with its morbidity and costs, and fertility can be spared substantially.

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