# Outcome of pregnancies after pelvic artery embolization for postpartum hemorrhage: retrospective cohort study

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**OBJECTIVE:** The effects of pelvic artery embolization (PAE) for postpartum hemorrhage (PPH) on subsequent pregnancies have been explored in small case series and one case-control study by mailed questionnaire with uncomplicated pregnancies as controls. We conducted a single-center retrospective cohort study using women with PPH without PAE for comparison.

**STUDY DESIGN:** From a cohort of 103 women undergoing PAE for primary PPH between January 1999 and December 2012 (exposed) and 189 pregnancies with PPH not requiring PAE between January 2008 and December 2012 (unexposed), we queried the electronic medical records for readmissions to labor and delivery in subsequent years. Outcomes of subsequent pregnancies continuing past 20 weeks were obtained by chart review.

**RESULTS:** Repeat pregnancies were documented in 17 of 103 exposed women (16.5%) and 18 of 189 unexposed women (9.5%). At delivery complicated by PPH, the groups did not differ in demographics, gestational age, units of blood transfused, or PPH cause. At the time of subsequent deliveries, there was a greater interdelivery interval in women exposed to PAE than those unexposed (1710 ± 938 days vs 904 ± 358 days; $P = .002$), and the 2 groups were similar in terms of gestational age and birthweight. However, there was a significantly higher rate of placenta accreta in exposed than unexposed women (23.5 % vs 0%; $P = .04$), with 3 of 17 sustaining total abdominal hysterectomy and 1 requiring repeat PAE for severe PPH.

**CONCLUSION:** Pregnancies following PAE for PPH were more likely than those not receiving PAE for treatment to be complicated by placenta accreta. Pregnancies following PAE should be followed up for imaging evidence of placenta accreta.

**Key words:** pelvic artery embolization, placenta accreta, postpartum hemorrhage

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Pelvic artery embolization (PAE) has become part of the obstetrician's armamentarium in the developed world as a fertility-sparing treatment of postpartum hemorrhage (PPH). There are multiple small case series of ongoing pregnancy following PPH. Some authors have reported complications including fetal growth restriction, recurrent PPH, and abnormal placentation,[1-4] whereas others suggest no sequelae of the procedure in subsequent pregnancies.[5-7]

The most recent reviews on the topic suggest that fertility can be preserved but that subsequent pregnancies may be at a small but enhanced risk for placental disorders and recurrence of PPH.[8,9] The only prior case-control study used, as controls, women with normal pregnancies who were contacted by a mail-in questionnaire; this study suggested no difference in obstetric outcomes between the 2 groups.[10]

Given the inconsistency in data regarding recurrent pregnancy after PAE for PPH and the relatively large experience with this procedure at Inova Alexandria Hospital, we have conducted a retrospective cohort study comparing women with PPH and receiving PAE with those with PPH not receiving PAE.

## Materials and Methods

Following institutional review board approval, we identified a cohort of 103 women with primary PPH at longer than 20 weeks and receiving PAE between January 1999 and December 2012 (exposed) and a second cohort of 189 women with primary PPH >20 weeks not requiring PAE between January 2008 and December 2012 (unexposed). The reason for the different time frames in the 2 groups was that there was an extant, ongoing database specifically for PAE since its inception at our hospital, but a new recording method for general obstetric complications was introduced in 2008.

PPH was defined by the need for transfusion, dilation and curettage procedure, PAE, and/or hysterectomy following delivery. For this analysis, patients requiring hysterectomy were necessarily excluded. Electronic medical charts were queried for readmissions to labor and delivery in subsequent years with pregnancies longer than 20 weeks.

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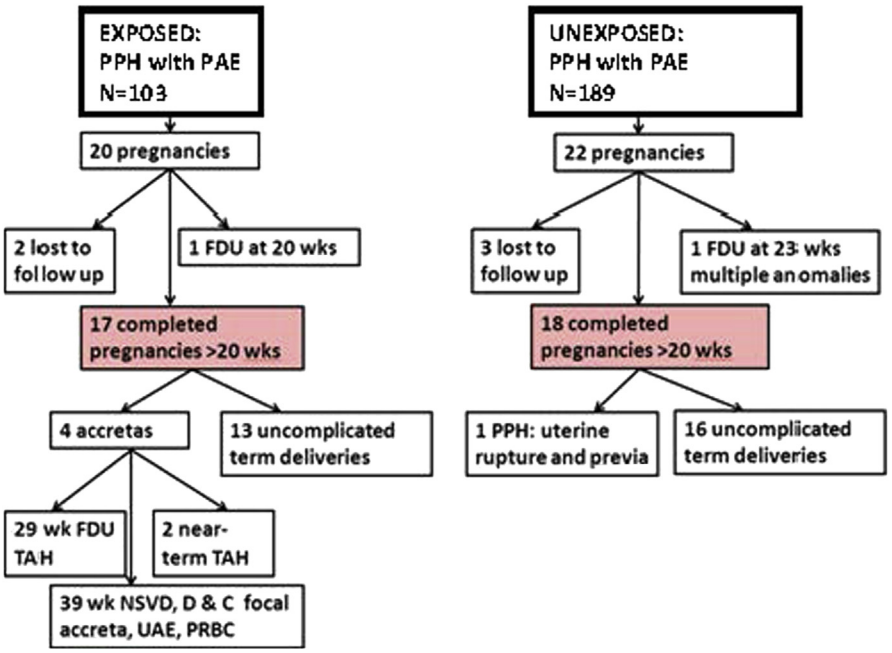
FIGURE
**Flowchart of patients with pregnancies after index PPH pregnancy**




*D and C*, dilation and curettage; *FDU*, fetal demise in uteru; *PAE*, pelvic artery embolization; *PPH*, postpartum hemorrhage; *PRBC*, packed red blood cells; *TAH*, total abdominal hysterectomy; *UAE*, uterine artery embolization.

*Poggi. Pregnancy after postpartum hemorrhage treated with pelvic artery embolization. Am J Obstet Gynecol 2015.*

Our electronic medical record system is centralized for Inova Health Systems, which comprises 7 hospitals in northern Virginia, allowing access to data on patients whose subsequent deliveries occurred in the region but not at our hospital. All diagnoses of PPH were confirmed by chart review; in the case of accreta, pathology records specifically were reviewed. Exposed and unexposed cohorts were compared for clinical factors at the index pregnancy, including maternal age, gestational age at delivery, parity, route of delivery, number of units of packed red blood cells (pRBCs) transfused, and causes of PPH.

Exposed and unexposed cohorts were also compared regarding subsequent delivery factors including interdelivery interval, gestational age at delivery, birthweight, route of delivery, recurrence of PPH, and cause of PPH. Statistical analyses included a Student *t* test for continuous data, a Mann-Whitney *U* test for nonparametric data, and a Fisher exact test for categorical data, with $P < .05$ considered significant.

## Results

From 103 pregnancies treated with PAE for PPH, we identified 17 ongoing pregnancies (16.5%), and from 189 pregnancies treated without PAE for PPH, we identified 18 ongoing pregnancies (9.5%) (Figure). Exposed and unexposed cohorts were well matched in terms of all clinical factors queried (Table 1), including etiology of PPH and units of blood transfused. As anticipated, there was a greater interval to a subsequent delivery in the exposed cohort than those unexposed, which likely reflects the earlier inception of the database specific to PAE (Table 2).

Recurrent PPH was observed in 23.5% of the cohort exposed to PAE, and in all 4 cases, this was due to pathology-proven accreta. Three patients received hysterectomies and the fourth received a dilation and curettage, blood products, and a repeat PAE (Table 3). In the unexposed group, there was 1 recurrent PPH requiring transfusion (5.5%), which was due to uterine rupture and placenta previa with a fetus in transverse lie and a repeat cesarean scar (Table 3).

## Comment

In our retrospective cohort of patients with PPH treated vs not treated with PAE, we observed a higher incidence of postpartum hemorrhage related to placenta accreta in subsequent pregnancies in the group receiving PAE. Almost 25% of such patients had pathology-proven placenta accreta, with 75% receiving a total abdominal hysterectomy.

A strength of our study is the retrospective cohort study design. A case-control study on the topic used normal pregnancies as controls and the format of a mailed-in questionnaire, with patient recollections available for 53 of 60 cases.[10] In this study, 2 of the 12 patients who had recurrent ongoing pregnancies experienced recurrent postpartum hemorrhage, although not serious enough to require PPH or PAE. In comparison with controls, fertility and obstetric outcomes were similar between the 2 groups. Our study had the advantage of larger numbers and a comparison cohort composed of patients who also experienced postpartum hemorrhage, well matched for degree of severity as evidenced by units of blood transfused.

In our series, the rate of ongoing pregnancy after PAE for PPH (16.5%) was in the lower range of that reported in a recent review of 22 case series (12–100%).[8] Obviously it is possible there were other cases with subsequent pregnancies who delivered outside our hospital system. That being said, a 100% fertility rate after PAE for PPH in any series suggests omission of patients not desiring or not able to conceive.

A potential weakness of our study was that the exposed and unexposed cohorts were obtained from databases originating in different years (exposed, 1999–2012; unexposed, 2008–2012). As anticipated, the rate of ongoing pregnancies in the unexposed women was lower (9.5%), most likely because the database was initiated later, so there was a shorter interval of time to allow for a repeat pregnancy.

The available literature on this topic indicates a wide variance in the incidence of placental accreta in pregnancies following PAE for PPH. Many authors have