Arterial Embolization for Primary Postpartum Hemorrhage

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PURPOSE: To evaluate the efficacy and safety of arterial embolization (AE) for treatment of primary postpartum hemorrhage (PPH), and the factors associated with clinical success.

MATERIAL AND METHODS: A retrospective analysis of all patients undergoing AE for primary PPH at three institutions ($N = 43$) from 1996 through 2007 was conducted. Patients with an antepartum diagnosis of invasive placenta were excluded from the study. Mean patient age was 31 years ± 5 (range, 21–40 y). Eighteen women (42%) were primiparous. Delivery details, transfusion requirements, hematology and coagulation results, embolization details, and clinical outcomes were collected. Clinical success was defined as cessation of bleeding without the need for repeat embolization, laparotomy, or hysterectomy after embolization; or death. The Fisher exact test was used to analyze nonparametric data.

RESULTS: The clinical success rate was 79% ($n = 34$). Four patients underwent successful repeat embolization. Two of 35 patients who had not undergone hysterectomy before embolization underwent hysterectomy for continued bleeding (without repeat embolization). One underwent hysterectomy 2 weeks after AE for uterine necrosis. One of eight patients who had undergone hysterectomy before AE required a laparotomy for a large retroperitoneal hematoma, and one patient died from cerebral anoxia secondary to hypotension despite repeat embolization. Clinical success was not related to mode of delivery, cause of PPH, transfusion requirements, time from delivery to embolization, or hysterectomy before AE ($P > .05$). Patients with active extravasation visualized angiographically were more likely to require repeat embolization (five of 13 [38%] vs 0 of 30 without extravasation; $P < .01$).

CONCLUSIONS: AE for primary PPH is safe and effective. Repeat embolization may be necessary in patients with active extravasation on angiography.

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Abbreviations: AE = arterial embolization, FFP = fresh frozen plasma, PPH = postpartum hemorrhage, PRBC = packed red blood cell, PVA = polyvinyl alcohol

HEMORRHAGE remains one of the most important causes of maternal mortality (1). The World Health Organization estimates a 1% case fatality rate for the 14 million annual cases of obstetric hemorrhage (2). Data from the United Kingdom suggest that, for each woman who dies from hemorrhage, a further 60 women undergo peripartum "hemostatic" hysterectomy (3).

Although arterial embolization (AE) to treat postpartum hemorrhage (PPH) was first reported in 1979 in a woman who had previously undergone bilateral hypogastric arterial ligation and hysterectomy (4,5) and there are now several case series reporting technical success and good clinical outcomes (**Table 1**), a recent Cochrane review (6) of randomized or quasirandomized controlled trials comparing pharmacologic, surgical, and radiologic interventions for the treatment of primary PPH found only one trial that met eligibility criteria (demonstrating a benefit of rectal misoprostol in PPH refractory to oxytocin).

A decision to perform uterine artery embolization is made on the basis of active or persistent bleeding despite appropriate medical treatment and obstetrical measures, but the precise role of embolization in the management of PPH is not yet clearly defined (7).

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Table 1
Studies of AE for Primary PPH with 10 or More Patients

Study, Year	No. of Pts.	Repeat AE (%)	Success (%)		Extravasation (%)	Major Complications
			Initial	Final		
Gilbert et al, 1992 (47)	10	25	75	100	NA	NA
Yamashita et al, 1994 (21)	15	NA	NA	86.6	100	None reported
Merland et al, 1996 (48)	16	NA	NA	15	NA	NA
Pelage et al, 1998 (33)	27	7.4	92.6	100	33	None reported
Deux et al, 2001 (25)	25	8	88	96	52	None reported
Chung et al, 2003 (34)	33	NA	NA	93.9	NA	None reported
Salomon et al, 2003 (38)	28	0	100	100	NA	Artery stenosis, buttock pain (n = 1 each)
Ornan et al, 2003 (49)	28	0	96.4	96.4	NA	Iliac artery perforation, small bowel infarction, buttock claudication (n = 1 each), 1 death from ARDS, HELLP syndrome
Descargues et al, 2004 (40)	29	NA	NA	100 (?*)	NA	NA
Vegas et al, 2006 (32)	27	7.4	88.9	96.3	92.6	Vaginal fistula
Soncini et al, 2007 (50)	14	0	92.8	92.8	36	None reported
Eriksson et al, 2007 (24)	20	35	65	100	30	Pelvic pain (n = 2), numbness (n = 3)
Touboul et al, 2008 (22)	102	13.7	57.8	71.5	NA	Ischemia lumbar plexus, gluteal pain (n = 1 each); 2 deaths
Chauleur et al, 2008 (23)†	46	0	89.1	89.1	NA	Hematoma, hemoperitoneum (epigastric artery dissection)
Maassen et al, 2009 (51)	11	18	63.8	81.8	NA	Vesicovaginal fistula; arterial embolus (n = 1 each)
Present study	43	11.6	76.4	88	30	Hematoma, arterial injury, necrotic fibroid tumor, endometritis, death (n = 1 each)

Note.—ARDS = acute respiratory distress syndrome; HELLP = hemolytic anemia, elevated liver enzymes, and low platelet count; NA = data not available.
* Success of embolization not explicitly stated.
† Includes the 2003 study of Tourne et al (35).

The purpose of the present study was to retrospectively review the efficacy and safety of selective AE as an alternative or adjunct to hysterectomy in the treatment of primary PPH, and to determine factors associated with clinical success.

MATERIALS AND METHODS

Patient Population and Selection

A retrospective analysis of all patients undergoing AE for primary PPH from 1996 to 2007 at three hospitals was conducted. Patients with an antepartum diagnosis of invasive placenta were excluded from the study population. Research ethics board approval was obtained from all three sites.

Etiology of the bleeding was determined in conjunction with the referring obstetrician. Hematology parameters including baseline, lowest, and immediate preembolization hemoglobin and platelet counts, and coagulation parameters including activated partial thromboplastin time, International Normalized Ratio, and fibrinogen level, were recorded. Volumes of transfused packed red blood cells (PRBCs), platelets, fresh frozen plasma (FFP), and cryoprecipitate were recorded for before and after embolization. Measures to control hemorrhage, including the administration of uterotonic drugs, fundal massage, uterine packing, and surgical interventions (including inspection for, and repair of, lower genital tract tears; manual exploration of the uterine cavity; uterine suturing; and uterine or hypogastric artery ligation or hysterectomy), were documented.

A decision to perform embolization was made on the basis of active continuing hemorrhage despite appropriate medical and obstetric treatment. The potential risks and benefits of the procedure were explained, and informed consent was obtained in all cases.

Characteristics of the Study Group

The patient cohort consisted of 43 patients (**Table 2**). Mean patient age was 31 years ± 5 (range, 21–40 y). Number of pregnancies, parity, mode of delivery, and gestational age were recorded. Eighteen women (42%) were primiparous.

Twenty-seven patients had vaginal delivery (63%), 11 of which were assisted (four with forceps, seven with vacuum). Sixteen patients underwent caesarean section (38%), with three elective and 13 emergent. The causes of PPH included uterine atony (n = 21; 49%), genital tract lacerations (n = 13; 30%), placenta previa (n = 5; 12%), uterine rupture (n = 2), uterine inversion (n = 1), and coagulopathy related to amniotic fluid embolism (n = 1). The mean interval between onset of bleeding and embolization was 10 hours, 41 minutes (median, 6 h).

Embolization Technique

In our hospitals, embolization is performed through a 4–5-F vascular sheath placed via the right common femoral artery. Internal iliac arteriography with selective study of the an-