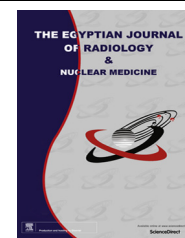




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ORIGINAL ARTICLE

Uterine artery embolization versus surgical management in primary atonic postpartum hemorrhage: A randomized clinical trial



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KEYWORDS

Atony;
 Postpartum hemorrhage;
 Uterine artery embolization;
 Stepwise devascularization
 B-lymph.

Abstract *Background:* Postpartum hemorrhage is the leading cause of severe maternal morbidity and death. A prompt management of uterine atony is life saving. Surgery can be needed in many cases. Uterine artery embolization (UAE) is a safe procedure and can be tried to be alternative to surgical approach.

Objective: To evaluate the clinical effectiveness and safety of uterine artery embolization (UAE) in comparison with stepwise devascularization and compression sutures in the treatment of postpartum hemorrhage (PPH).

Methods: Randomized controlled parallel-group trial included twenty-three women with postpartum hemorrhage who were treated with either selective embolization of the uterine arteries or stepwise devascularization and compression sutures after failure of conservative measures.

Results: Technical success was achieved in 9 patients (81.8%) of cases with complete cessation of the bleeding, while 2 cases (18.2%) suffered DIC and needed hysterectomy in the UAE group, while the other group (12 patients) had stepwise devascularization and compression sutures done after failure of the conservative measures, with 3 cases who needed hysterectomy after failure of these methods.

Conclusions: Uterine artery embolization is a safe, minimally invasive and effective method for treatment of postpartum hemorrhage and is alternative to surgical management.

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1. Introduction

Obstetric hemorrhage continues to be the single most important cause of maternal mortality worldwide, accounting for 25–30% of all maternal deaths, and it represents the most common maternal morbidity in the developed world (1).

Abbreviations: PPH, postpartum hemorrhage; UAE, uterine artery embolization.

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Postpartum hemorrhage (PPH), defined as blood loss exceeding 500 ml, is a common entity that complicates as many as 18% of all deliveries (2).

Uterine atony is the commonest cause of postpartum hemorrhage (3). Placenta accreta, lower genital tract tears, retained placental products, rupture uterus and coagulopathy are less common causes (4).

Conservative treatment consists of vaginal packing, intake of uterotonic drugs, and surgical repair of genital tract tears. If the bleeding persists despite conservative measures, surgical ligation of uterine vessels or hysterectomy is done (5).

UAE has been shown to be associated with high technical success rates and good clinical outcomes for the treatment of primary and secondary PPH (6).

Uterine artery embolization has several advantages, including easy identification of the bleeding site, preservation of the uterus and fertility, and decreased recurrent bleeding from collaterals with more distal occlusion of the bleeding vessels (7).

The purpose of this study was to evaluate the efficacy and safety of management of PPH by UAE versus selective devascularization and compression sutures.

2. Patients and methods

This prospective randomized trial was conducted at Ain-Shams University Maternity Hospital. Participants were recruited from the labor suit who developed 1ry postpartum in the 1st 2 h after birth and no satisfactory response to medical management. Exclusion criteria were as follows: history of coagulopathy, thrombocytopenia or anticoagulant therapy, women with HELLP syndrome or eclampsia, impaired serum creatinine and mental conditions rendering the patient unable to understand the nature, scope and possible consequences of the study.

Women participating in the study were recruited during the period between may 2011 till may 2013. The patients were randomized using computer generated list (MedCalc Version 13.2.2, Acacialaan 22, Ostend, Belgium) in a 1:1 ratio into 2 groups. The randomization protocol was also concealed using closed envelopes so that each envelope contained the name of one of the 2 options.

Approval was obtained from the ethical committee of the department of Obstetrics and Gynecology, Ain-Shams University. An oral consent was obtained from each participant before proceeding to either of the options.

Twenty-four women with atonic postpartum hemorrhage were included after failure to respond to uterotonics.

The age range of the women included was 26–35 years with mean age 29.5 years.

The patients were divided into two groups: Group I included 11 patients (as one of the women refused to have UAE) who underwent UAE while group II underwent emergency laparotomy for stepwise devascularization and compression sutures after failure of conservative management. Group one had 9 patients who delivered vaginally and 2 by cesarean section, group 2 had 8 patients who delivered by the vaginal route while 4 others delivered by cesarean section. The patients were encountered in the delivery room where they were diagnosed as primary postpartum hemorrhage, with excessive blood loss (more than 1000 ml) with affection of the general condition of the patients. Vital data were recorded and

conservative measures were started in the following sequence, giving ecbolics (10 units oxytocin IV bolus and 30 units oxytocin on 500 ml saline infusion drip), uterine massage, and bimanual compression of the uterus. If these measures failed to control the bleeding after 15 min (blood loss still above the average), the patients were allocated to one of the groups (group I the UAE or group II the stepwise devascularization and compression sutures).

If the patient was to perform a stepwise devascularization and compression sutures, the obstetric team proceeded to a laparotomy via a low transverse incision, and bilateral uterine artery ligation was done using vicryl 1.0 sutures at a lower level after downward dissection of the bladder, and if this did not control the bleeding, compression of the uterus by B-lynch sutures was done using vicryl 1.0 sutures. If these maneuvers failed to control the bleeding, bilateral internal iliac artery ligation was done. As a final resort if the bleeding did not stop a hysterectomy was done. If the patient was to be randomized to the UAE group the patient was transferred immediately to the radiology department and the following procedure done.

2.1. Technique of uterine artery embolization

The procedures were done under fluoroscopic control using monoplane cath-laboratory unit (Toshiba-Japan) with a 5F sheath (TERUMO) and a 5F Cobra2 catheter (Cordis) with a 0.35F hydrophilic guide wire (TERUMO).

In this technique the cobra catheter was advanced with the guide wire toward the level of the aortic bifurcation then the guide wire was withdrawn and contrast injection was done to identify the contralateral internal iliac artery origin and then through a road mapping; the origin of the left uterine artery was identified and catheterized and embolization was completed by injection of gel foam pledges till stagnation of contrast in the main stem of the uterine artery was achieved. After that the catheter was withdrawn after proper aspiration and flushing was done and then the ipsilateral internal iliac and uterine arteries were catheterized by formation of a Waltman loop (which is a long reversed loop obtained with the cobra catheter) and then withdrawal of the catheter to select the ipsilateral (right) uterine artery and the process of embolization started by gel foam pledges (Fig. 1) to obtain the same stagnation of contrast along the right uterine artery and then control aortogram was done to rule out any extra arterial supply and to ensure proper embolization (Figs. 2 and 3).

The sheaths were left in place for 24 h and the patients were transferred to the ICU.

3. Results

Among 30 women interviewed, 24 were enrolled in the study. One patient was subsequently excluded as she withdrew her approval to have UAE (Fig. 4).

So the two groups of women were as follows: group I ($n = 11$), including women who underwent uterine artery embolization (UAE); and group II ($n = 12$), including women who underwent stepwise devascularization and compression sutures. There were no significant differences between women of both groups regarding initial characteristics (Table 1). Most of the cases in both groups had primary atonic PPH (72.7% and 75%, respectively); the remainder had either extensive



Fig. 1 Gel foam sheet which is then cut into pledges.



Fig. 2 Thirty-two years old women presented with atonic postpartum hemorrhage after vaginal delivery. Selective right (a) and left (c) uterine arteries catheterization with evidence of active extravasation of the contrast during the uterine artery angiogram. Angiogram of right (b) and left (d) uterine arteries after the embolization showing disappearance of the extravasation.

lacerations or placental-site bleeding. The baseline maternal pulse rate was slightly higher and the baseline hemoglobin concentration was slightly lower in women of group II; these differences were, however, statistically insignificant. The rates of overt DIC were comparable in both groups [2 (18.2%) vs. 3 (25%), $p = 0.999$] (Table 2).

Among women of group I, UAE was successful in control of bleeding in 9 (81.8%) women, and was a failure in 2 (18.2%) women, who needed hysterectomy. UAE, therefore, was significantly associated with almost 5-fold reduction in the rate of hysterectomy for intractable primary PPH [RR = 0.18, 95% CI (0.05–0.64)]. Interestingly, 2 women

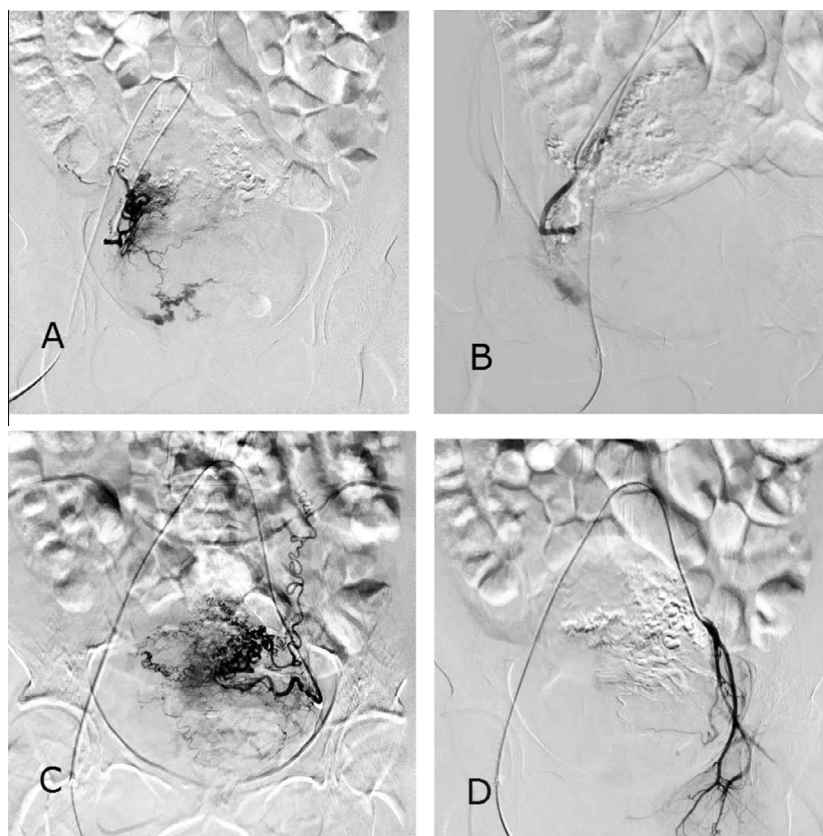


Fig. 3 Twenty-eight years old woman presented with atonic PPH after cesarean section. Selective right (a) and left (c) uterine arteries catheterization with evidence of active extravasation of the contrast during the uterine artery angiogram. Angiogram of right (b) and left (d) uterine arteries after the embolization showing disappearance of the extravasation.

who failed to respond to UAE and needed hysterectomy had overt DIC, while in group II the stepwise devascularization and compression sutures were successful in 9 patients (75%) with 3 patients needing hysterectomy who also suffered from DIC (25%).

The rate of postpartum fever ($> 38.5^{\circ}\text{C}$) was slightly (but not significantly) higher in women of group I. The rate of complications was comparable in both groups (Table 3). In group I, complications included 1 (9.1%) case of sepsis requiring subsequent hysterectomy and 1 (9.1%) case of prolonged gluteal pain. In group II, complications included 1 (8.4%) case of acute renal failure requiring temporary hemodialysis and 1 (8.4%) case of inadvertent bladder injury that was immediately repaired with no late sequelae.

4. Discussion

Postpartum hemorrhage is one of the most common causes of maternal mortality (8) and occurs in approximately 5% of all deliveries (9,10). Conservative treatment is based on control uterine atony by administration of uterotonic drugs and vaginal packing as well as surgical repair of lower genital tract lacerations (11). Surgical ligation of uterine arteries or internal iliac arteries is frequently performed when the conventional way cannot control the bleeding. In 50% of the patients with severe postpartum hemorrhage, the ligation of internal-

iliac-artery may not be effective in controlling bleeding as proposed by three groups of researchers (12–14). This is due to the fact that blood flow in the distal vessel is only decreased by 48% due to the presence of multiple collateral vessels in the distal internal iliac artery (15). Uterine artery ligation is more effective especially in management of uterine atony; however, it is less effective in the presence clotting disorders or placenta accreta (16,17).

Hysterectomy is done if conservative measures have failed to stop the bleeding. This procedure has high morbidity rates and leads to loss of subsequent fertility (18).

The embolization of uterine arteries was initially performed to control tumor (19,20) or traumatic (21) bleeding and recently embolization has been used for treatment of uterine myomas (22). The first case of percutaneous arterial embolization for postpartum hemorrhage was reported by Brown et al. in 1979 (23). These researchers catheterized and embolized a pudendal artery. Embolization of uterine arteries, vaginal arteries, pudendal arteries and ovarian arteries was reported in the literature (24,25). When a surgical procedure was performed before embolization, arteries such as lumbar, sacral, medial circumflex, or pelvic arteries were also embolized (26,27).

According to our study, the most common cause of postpartum hemorrhage is uterine atony as reported in the literature (3).

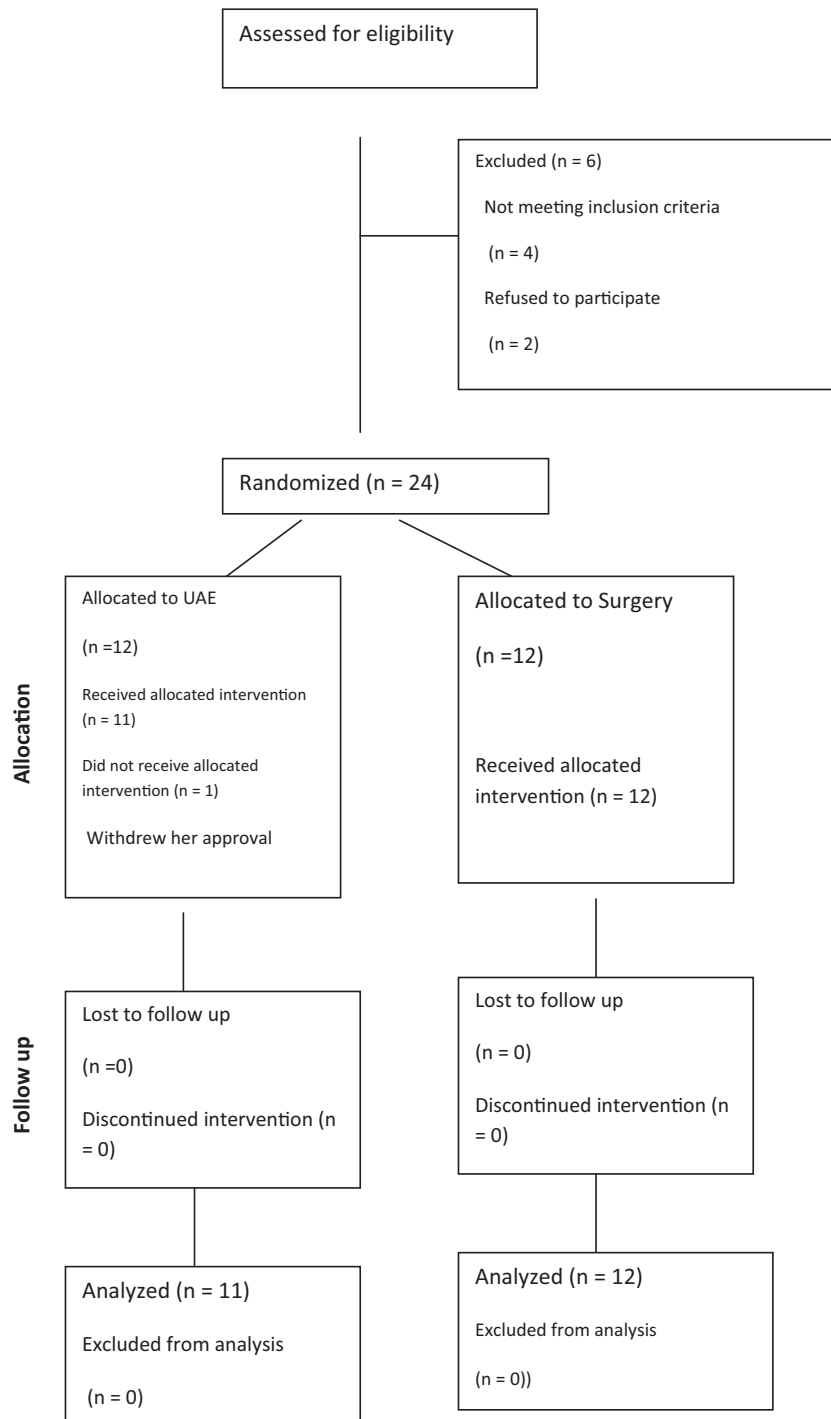


Fig. 4 CONSORT diagram showing the flow of participants through each stage of a randomized trial.

In the current study, embolization was done using the gel foam to ensure transient devascularization in order to preserve the fertility of the patients. Moreover, clotting disorders generally improved rapidly after embolization.

All patients in the UAE group were treated by a symmetrical bilateral embolization in one session. Vascular spasms were encountered in our study in 20% of the patients and have been reported in other studies (25). These make selective

catheterization more difficult and seem more frequent in women who have been treated with adrenaline.

We injected vasodilator agent through the catheter into the spastic artery to relieve the spasm and permit selective catheterization, as we reported in one patient. Also we stopped vasopressor infusion at the beginning of embolization to limit spasms.

Our 81.8% success rate can be compared with the 85–95% success rates reported in previous series (25,27,28).

Table 1 Difference between Groups regarding Initial Characteristics.

	Group I [UAE Group] (<i>n</i> = 11)	Group II [Stepwise devascularization and compression sutures group] (<i>n</i> = 12)	<i>P</i>
Age (years)	29.54 ± 4.41	29.92 ± 3.60	0.827*
BMI (kg/m ²)	26.21 ± 2.60	27.42 ± 4.75	0.463*
Parity	2 (2–3)	3 (2–3)	0.081**
<i>Mode of delivery</i>			
Vaginal delivery	9 (81.8%)	8 (66.7%)	0.725***
Cesarean delivery	2 (18.2%)	4 (33.3%)	

BMI, body mass index [calculated as weight (kg) divided by squared height (m²)].

UAE, uterine artery embolization.

Data presented as mean ± SD; median (interquartile range); or number (percentage).

* Analysis using independent Student's *t*-test.

** Analysis using Mann–Whitney *U*-test.

*** Analysis using chi-squared test.

Table 2 Difference between Groups regarding Baseline Pulse Rate and Hb Concentration.

	Group I [UAE group] (<i>n</i> = 11)	Group II [Stepwise devascularization and compression sutures group] (<i>n</i> = 12)	<i>P</i>
Pulse rate (bpm)	120 (100–125)	125 (110–135)	0.113*
Hb concentration (g/dl)	7 (6–7)	6 (5–7)	0.152*
Overt DIC	2 (18.2%)	3 (25%)	0.999**

Hb, hemoglobin.

DIC, disseminated intravascular coagulopathy.

Data presented as median (interquartile range).

* Analysis using Mann–Whitney *U*-test.

** Analysis using chi-squared test.

Table 3 Difference between groups regarding complications and postpartum fever.

	Group I [UAE group] (<i>n</i> = 11)	Group II [Stepwise devascularization and compression sutures group] (<i>n</i> = 12)	<i>P</i>
Complications	2 (18.2%)	2 (16.7%)	0.999*
Fever (> 38.5°)	3 (27.3%)	2 (16.7%)	0.912*
Hysterectomy	2 (18.2%)	3 (25%)	

Data presented as number (percentage).

* Analysis using chi-squared test.

In our study, clotting disorders improved rapidly after embolization, as mentioned in other reports. Pelage et al. in their study hypothesized that embolization of the uterine arteries initiates uterine contractions which lead to liberation of procoagulant factors into circulation. Embolization could be considered as a site-specific treatment to break the vicious circle of acute hemostatic and vascular disorders (25).

No major complications were observed in our series, but only minor complications including fever which was found in

3 patients. One patient suffered from sepsis requiring hysterectomy 2 months later and one patient suffered gluteal pain. Local hematomas and pelvic pain are minor complications reported in the literature (29). The major complications reported in other series included perforation of the external iliac artery small-bowel infarct (27) and vaginal abscess (29).

In our study, menstruation resumed in all patients as mentioned in the literature (28,30) and one patient got pregnant

which confirms the preservation of maternal fertility after uterine embolization as reported in the literature (25,30).

Our study confirms that embolization is a safe and effective technique for treatment of severe postpartum hemorrhage and that this measure of treatment should be proposed before surgery. The most important advantage of uterine embolization is the preservation of the uterus particularly in women desiring another pregnancy. Transient occlusion of uterine arteries by temporary occluding material as gel foam can be considered as an advantage to definitive surgical ligation. Furthermore, the improvement of clotting disorders after embolization is another advantage. The improvement of multidisciplinary treatment for postpartum hemorrhage is necessary to allow a rapid decision to perform embolization; this change would probably increase the number of patients that could benefit from this minimally invasive treatment.

5. Conclusion

We concluded that uterine artery embolization is an effective tool in the management of post-partum hemorrhage.

Conflict of interest

We have no conflict of interest to declare.

References

- (1) Devine PC. Obstetric hemorrhage. *Semin Perinatol* 2009;33:76–81.
- (2) Elbourne DR, Prendiville WJ, Carroli G, Wood J, McDonald S. Prophylactic use of oxytocin in the third stage of labour. *CochraneDatabase Syst Rev* 2001;CD001808.
- (3) Varner M. Postpartum hemorrhage. *Crit Care Clin* 1991;7:883–97.
- (4) Jouppila P. Postpartum haemorrhage. *Curr Opin Obstet Gynecol* 1995;7:446–50.
- (5) Roberts WE. Emergent obstetric management of postpartum hemorrhage. *Obstet Gynecol Clin North Am* 1995;22:283–302, 6.
- (6) Kirby JM, Kachura JR, Rajan DK, et al. Arterial embolization for primary postpartum hemorrhage. *J Vasc Interv Radiol* 2009;20:1036–45.
- (7) Badaway SZA, Etman A, Singh M, Murphy K, Mayelli T, Philadelphia M. Uterine artery embolization: the role in obstetrics and gynecology. *J Clin Imag* 2001;25:288–95.
- (8) Goffinet F, Haddad B, Carbonne B, Sebban E, Papiernik E, Cabrol D. Practical use of sulprostone in the treatment of hemorrhages during delivery [in French]. *J Gynecol Obstet Biol Reprod* 1995;24:209–16.
- (9) Combs CA, Murphy EL, Laros RK. Factors associated with hemorrhage in cesarean deliveries. *Obstet Gynecol* 1991;77:77–82.
- (10) Combs CA, Murphy EL, Laros Jr RK. Factors associated with postpartum hemorrhage with vaginal birth. *Obstet Gynecol* 1991;77:69–76.
- (11) Goffinet F, Haddad B, Carbonne B, Sebban E, Papiernik E, Cabrol D. Practical use of sulprostone in the treatment of hemorrhages during delivery [in French]. *J Gynecol Obstet Biol Reprod* 1995;24:209–16.
- (12) Clark SL, Phelan JP, Yeh SY, Bruce SR, Paul RH. Hypogastric artery ligation for obstetric hemorrhage. *Obstet Gynecol* 1985;66:353–6.
- (13) Chattopadhyay SK, Deb Roy B, Edrees YB. Surgical control of obstetric hemorrhage: hypogastric artery ligation or hysterectomy? *Int J Gynaecol Obstet* 1990;32:345–51.
- (14) Fernandez H, Pons JC, Chambon G, Frydman R, Papiernik E. Internal iliac artery ligation in postpartum hemorrhage. *Eur J Obstet Gynecol Reprod Biol* 1988;28:213–20.
- (15) Burchell RC. Physiology of internal iliac artery ligation. *J Obstet Gynaecol Br Commonw* 1968;75:642–51.
- (16) Fahmy K. Uterine artery ligation to control postpartum hemorrhage. *Int J Gynaecol Obstet* 1987;25:363–7.
- (17) O'Leary JL, O'Leary JA. Uterine artery ligation in the control of intractable postpartum hemorrhage.
- (18) Zelop CM, Harlow BL, Frigoletto Jr FD, Safon LE, Saltzman DH. Emergency peripartum hysterectomy. *Am J Obstet Gynecol* 1993;168:1443–8.
- (19) Rosch J, Dotter CT, Brown MJ. Selective arterial embolization: a new method for control of acute gastrointestinal bleeding. *Radiology* 1972;102:303–6.
- (20) Goldstein HM, Medellin H, Ben-Menachem Y, Wallace S. Transcatheter arterial embolization in the management of bleeding in the cancer patient. *Radiology* 1975;115:603–8.
- (21) Margolies MN, Ring EJ, Waltman AC, Kerr Jr WS, Baum S. Arteriography in the management of hemorrhage from pelvic fractures. *N Engl J Med* 1972;287:317–21.
- (22) Worthington-Kirsch RL, Popky GL, Hutchins Jr FL. Uterine arterial embolization for the management of leiomyomas: quality-of-life assessment and clinical response. *Radiology* 1998;208:625–9.
- (23) Brown BJ, Heaston DK, Poulson AM, Gabert HA, Mineau DE, Miller Jr FJ. Uncontrollable postpartum bleeding: a new approach to hemostasis through angiographic arterial embolization. *Obstet Gynecol* 1979;54:361–5.
- (24) Mitty HA, Sterling KM, Alvarez M, Gendler R. Obstetric hemorrhage: prophylactic and emergency arterial catheterization and embolotherapy. *Radiology* 1993;188:183–7.
- (25) Pelage JP, Le Dref O, Mateo J, et al. Life-threatening primary postpartum hemorrhage: treatment with emergency selective arterial embolization. *Radiology* 1998;208:359–62.
- (26) Collins CD, Jackson JE. Pelvic arterial embolization following hysterectomy and bilateral internal iliac artery ligation for intractable primary post partum haemorrhage. *Clin Radiol* 1995;50:710–4.
- (27) Greenwood LH, Glickman MG, Schwartz PE, Morse SS, Denny DF. Obstetric and nonmalignant gynecologic bleeding: treatment with angiographic embolization. *Radiology* 1987;164:155–9.
- (28) Yamashita Y, Harada M, Yamamoto H, et al. Transcatheter arterial embolization of obstetric and gynaecological bleeding: efficacy and clinical outcome. *Br J Radiol* 1994;67:530–4.
- (29) Gilbert WM, Moore TR, Resnik R, Doemeny J, Chin H, Bookstein JJ. Angiographic embolization in the management of hemorrhagic complications of pregnancy. *Am J Obstet Gynecol* 1992;166:493–7.
- (30) Stancato-Pasik A, Mitty HA, Richard III HM, Eshkar N. Obstetric embolotherapy: effect on menses and pregnancy. *Radiology* 1997;204:791–3.