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# Arterial embolisation in intractable primary post-partum haemorrhage: case series

## 以動脈內栓塞術處理原發性產後出血不止的病例系列報告

**Objective.** To evaluate the efficacy and safety of arterial embolisation in the management of intractable primary post-partum haemorrhage.

**Design.** Retrospective case series.

**Setting.** Regional hospital, Hong Kong.

**Patients.** Nine patients aged 28 to 39 years who were treated for severe primary post-partum haemorrhage between October 2000 and January 2003.

**Intervention.** Emergency transcatheter arterial embolisation.

**Main outcome measures.** Clinical outcome and complications.

**Results.** All nine arterial embolisations successfully arrested the haemorrhage. The main cause of primary post-partum haemorrhage was uterine atony. No serious complication arose, although one patient experienced slight numbness of the right leg. Normal menstruation resumed in all patients, except for the one who had had a hysterectomy as initial treatment. One patient became pregnant 1 year after embolisation. Patients were followed up for 10 months.

**Conclusion.** In our experience, arterial embolisation is safe and efficacious, and is the treatment of choice for patients with intractable primary post-partum haemorrhage.

**目的：**評估以動脈內栓塞術處理原發性產後出血不止的功効以及安全程度。

**設計：**對一連串病例的回顧研究。

**安排：**一所分區醫院，香港。

**患者：**2000年10月至2003年1月期間，9位年齡由28至39歲的病人因原發性產後嚴重出血，須接受治療。

**療法：**經導管動脈內栓塞術急救。

**主要結果測量：**臨床結果和併發症。

**結果：**9宗動脈內栓塞術全部成功止血。造成原發性產後出血的主因是子宮收縮乏力。1位病人在手術後右腿麻痺，但沒有病人出現嚴重併發症。除1位最初施以子宮切除術止血外，其他病人經期回復正常。1位病人接受動脈內栓塞術後1年再次懷孕。所有病人的隨訪期為10個月。

**結論：**我們的經驗顯示，以動脈內栓塞術處理原發性產後出血不止，是一種安全有效的治療措施。

### Key words:

Embolization;  
 Gelatin sponge, absorbable;  
 Postpartum hemorrhage

### 關鍵詞：

栓塞術；  
 明膠海綿，吸收性；  
 產後出血

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### Introduction

Primary post-partum haemorrhage (PPH) remains one of the major causes of maternal morbidity and mortality around the world.<sup>1</sup> Most cases can be managed conservatively. However, cases of intractable bleeding require more aggressive treatment: conventionally, uterine artery ligation, internal iliac (hypogastric) artery ligation, or even hysterectomy.<sup>1</sup> Ligation of the internal iliac artery carries a greater risk and is technically more challenging than uterine artery ligation. In two studies of a total of 37 patients, the procedure had a failure rate of more than 50%, because of the rich collateral circulation in the pelvis.<sup>2,3</sup> Hysterectomy is performed if arterial ligation fails, but it carries a high operative risk and morbidity, because of the vascularity and anatomical changes in the gravid uterus and supporting structures.<sup>4</sup> Hysterectomy also results in loss of a patient's reproductive potential.<sup>5</sup> In addition, as an alternative to hysterectomy, B-Lynch suture techniques (fundus compression suturing) have limited experience in safety and efficacy.<sup>6</sup>

A previous study in our unit at the Pamela Youde Nethersole Eastern Hospital (PYNEH) yielded a high success rate of hysterectomy as the definitive treatment of primary PPH—all seven patients in the study with life-threatening PPH successfully underwent hysterectomy after failure of conservative measurements. Still, hysterectomy resulted in complications, such as urological injuries, paralytic ileus, thromboembolism, disseminated intravascular coagulopathy, and wound infection.<sup>7</sup>

Because of advances in interventional radiology, arterial embolisation has become a highly effective alternative method of controlling bleeding while potentially preserving reproductive ability. So far, there has not been a local study on the use of arterial embolisation for primary PPH. The goal of this study was to review the management of intractable obstetric haemorrhage with arterial embolisation in terms of procedures, results, and complications during a 28-month period at the PYNEH.

## Methods

Between October 2000 and January 2003, a total of 9263 women gave birth in our unit, of whom 22 had severe primary PPH of more than 1 L. Nine patients aged 28 to 39 years (mean, 33 years) had uncontrolled primary PPH that was treated by arterial embolisation. All procedures were performed as emergency cases within 3 hours of presentation. Four of the nine patients were primiparous and five patients were multiparous. During the study period, only one patient had hysterectomy performed as the first treatment for severe primary PPH (case 2). Surgical

ligation of the internal iliac artery was not attempted during hysterectomy for this patient because there was evidence of disseminated intravascular coagulopathy with generalised oozing from raw surfaces, which precluded surgical dissection. Bleeding continued after hysterectomy; hence, abdominal packing was done, and bleeding was finally controlled by embolisation of the bilateral internal iliac arteries. Abdominal packing was removed on the next day.

At the PYNEH, radiologists who are experienced in angiographic and interventional skills are available 24 hours a day. All cases are initially managed by conservative measures, consisting of manual uterine massage; bimanual compression; administration of oxytocin, rectal misoprostol, or prostaglandin E<sub>2</sub> analogues (sulprostone); transfusion of blood products; and fluid resuscitation. During the study period, however, Carboprost (Hemabate, Upjohn, MI, US), a potent synthetic prostaglandin analogue, was not available in our unit. Among our cases, the decision to perform arterial embolisation was made on the basis of active continuous bleeding despite conservative measures (n=8), and surgical treatment (n=1). A consulting obstetrician was involved in the decision to perform embolisation in all cases.

Informed consent was obtained from patients after they and their family had received an explanation of the potential risks and benefits of procedures. Coagulation abnormalities and disseminated intravascular coagulopathy were present in all cases and were corrected before the procedure by the administration of fresh frozen plasma

**Table. Clinical characteristics of nine patients who underwent selective arterial embolisation**

Case No.	Age (years)	Parity	Maturity (weeks)	Mode of delivery/ indication*	Estimated blood loss (mL)	Aetiology	Treatment before embolisation	Arteries embolised	Procedure time (min)	Success
1	37	0 <sup>+1</sup>	40 <sup>+2</sup>	CS, breech	3000	Uterine atony	Conservative <sup>†</sup>	Internal iliac	50	Yes
2	36	1 <sup>+1</sup>	33 <sup>+1</sup>	CS, PP (type IV) APH	8000	Morbid adherent placenta	Hysterectomy + abdominal packing	Internal iliac	35	Yes
3	31	0	40 <sup>+1</sup>	VE, prolonged 2nd stage	10600	Uterine atony	Conservative	Internal iliac	75	Yes
4	29	0	41	SVD, MROP, adherent placenta	3000	Uterine atony	Conservative	Uterine	120	Yes (subsequent pregnancy)
5	30	0	41	SVD	6450	Uterine atony	Conservative	Internal iliac	65	Yes
6	39	2 <sup>+6</sup>	37 <sup>+6</sup>	VE, prolonged 2nd stage MROP, adherent placenta	3730	Uterine atony	Conservative	Uterine	85	Yes
7	35	1 <sup>+1</sup>	36 <sup>+2</sup>	CS, PP (type IV) APH	5300	Morbid adherent placenta	Conservative	Internal iliac	75	Yes
8	30	1	41 <sup>+3</sup>	SVD	3000	Uterine atony	Conservative	Internal iliac	110	Yes
9	28	1	39 <sup>+3</sup>	SVD, MROP, adherent placenta	5000	Uterine atony	Conservative	Internal iliac	75	Yes

\* CS: caesarian section; PP: placenta praevia; APH: antepartum haemorrhage; VE: vacuum extraction; SVD: spontaneous vaginal delivery; MROP: manual removal of placenta

† Manual uterine massage, oxytocin, rectal misoprostol, prostaglandin E<sub>2</sub> analogues, intravenous fluid resuscitation, and blood product transfusion

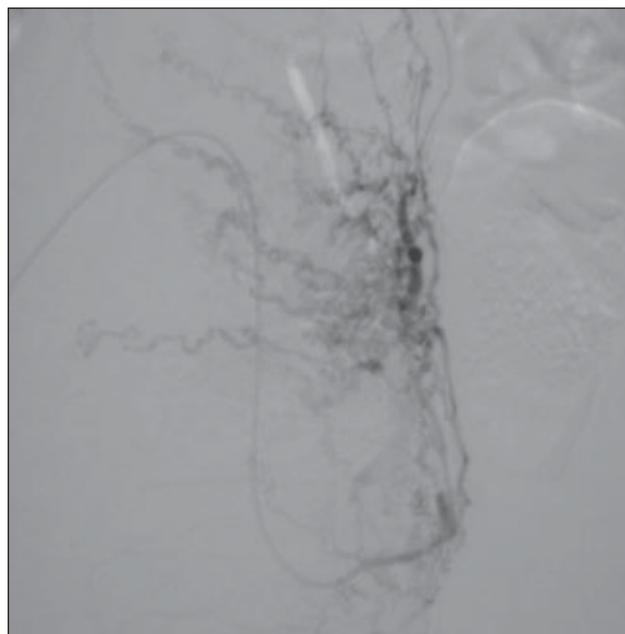
and platelet concentrate. All patients were transferred to the Department of Radiology, and angiography was performed by interventional radiologists using the right femoral approach with a 5-French (F) arterial sheath. Femoral artery puncture and catheterization were performed under local anaesthesia with 1% w/v lignocaine. Prophylactic antibiotics (ampicillin and metronidazole) were given intravenously in all cases. Pelvic arteriography was performed through a 5-F pigtail catheter, followed by angiography of either the internal iliac or uterine arteries using a 5-F cobra-shaped catheter (Cobra; Cordis, the Netherlands). Embolisations were performed using absorbable gelatin sponge pieces (Gelfoam) [Spongostan; Johnson & Johnson Medical Limited, Skipton, UK]. Post-embolisation arteriography of the internal iliac or uterine arteries was performed to ensure the complete occlusion of the bleeding vessels. All patients were transferred to the intensive care unit (ICU) or the labour ward for further treatment. The femoral artery sheaths were left in situ until the coagulation disorder was corrected.

## Results

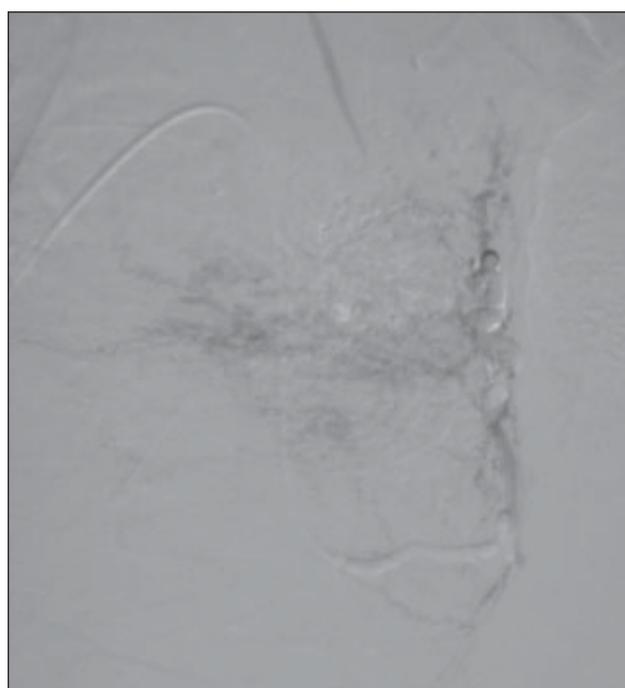
Eight of the nine patients delivered infants at 36 to 41 weeks of gestation; the exception was the patient in case 2, who gave birth at 33 weeks' gestation (by caesarean section because of major placenta praevia and antepartum haemorrhage). In all, three patients underwent caesarean section and six patients delivered vaginally. The main clinical indication for arterial embolisation was intractable bleeding due to uterine atony for seven patients. Another cause of bleeding was morbidly adherent placenta in the remaining two cases (cases 2 and 7).

Eight of the nine cases were initially managed by conservative measures; the remaining case (case 2) initially underwent a hysterectomy. The decision for embolisation was made on the basis of active continuous haemorrhage despite conservative management. Clinical and treatment profiles of the nine patients are summarised in the Table. The mean blood loss was 5342 mL. The average blood transfusion before embolisation was 6 to 7 units of blood per patient.

Angiography showed extravasation of contrast material in four patients (cases 2, 3, 7, and 8). Tortuous and hypertrophic intrauterine arteries related to pregnancy were seen in five patients (cases 1, 4, 5, 6, and 9). The angiographic findings for case 4 are shown in Figs 1 and 2. Bilateral uterine artery embolisations were performed in two patients (cases 4 and 6). For the other seven patients, all of whom had severe vasoconstriction of uterine arteries; hence, selective cannulations of uterine arteries were not possible. Embolisations of bilateral internal iliac arteries were performed instead. Gelfoam was used as the embolic material in all patients. The embolisation procedures lasted 35 to 120 minutes. Oxytocin infusions (Syntocinon 30 units in 500 mL 0.9% normal saline at 90 mL per hour) were



**Fig 1. Selective left uterine arteriogram of a 29-year-old patient with severe post-partum haemorrhage (case 4)**  
Note the hypervascularity of the left uterine artery



**Fig 2. Post-embolisation of left uterine arteriogram following bilateral Gelfoam embolisation of the uterine arteries (case 4)**  
Note the occlusion of embolised artery and diminished vascularity of the uterus

continued after embolisation because of the presence of collateral vessels.

Vaginal bleeding decreased immediately after embolisation in all patients. Mild persistent oozing of blood from the vagina was seen in two patients (cases 1 and 7),

but it was controlled by an intramyometrial injection of Syntometrine (5 units of oxytocin and 0.5 mg ergometrine maleate). In the woman who had undergone hysterectomy that failed to control the bleeding (case 2), embolisation of the bilateral internal iliac arteries was performed successfully.

Six patients had a transient post-procedure fever to 38.5°C, which resolved in 1 to 2 days. One patient (case 4) experienced mild transient numbness of the right thigh after embolisation. No other complications related to the embolisation procedure were encountered. After embolisation procedure, all patients were kept fasting until their reassessment. Their diets were resumed when their condition had stabilised. The duration of fasting was related to the individual condition and not to the embolisation procedure. The mean fasting time ranged from 4 to 24 hours. Two patients required paracetamol and six patients required dologesics for both post-procedural pain and delivery-related pain. One patient did not request any analgesics.

Eight of the nine cases required ICU stay. The mean length of stay in ICU was 1 day. The patients were discharged home when haemostasis was well controlled and vital signs were stable and no ischaemic complications present. The mean total duration of hospitalisation was 6 days. In the eight patients who did not undergo hysterectomy, menstruation resumed 3 to 8 months after embolisation but according to the patients, the bleeding was reduced in amount. One of the eight women became pregnant 1 year after embolisation. No complication was found in the 10 months' follow-up after the embolisation procedures.

## Discussion

Although our studied population is small, the 100% success rate is similar to that reported in other cases, for which the overall success rate is over 90% for selective arterial embolisation in the obstetric setting.<sup>8-11</sup> In the past, surgical ligation of the internal iliac arteries with or without hysterectomy was the only treatment option available.<sup>1</sup> Now arterial embolisation is available, it should be considered the treatment of choice for cases of severe primary PPH that do not respond to conservative measures, such as manual uterine massage; bimanual compression; administration of oxytocin, rectal misoprostol, or prostaglandin E<sub>2</sub> analogues; transfusion of blood products; and fluid resuscitation. With the availability of specialists and facilities in arterial embolisation, the procedure is a safe alternative to surgery. It has the advantage that in the event of failure to control the bleeding, embolisation does not preclude surgical intervention.<sup>12</sup> In contrast, if internal iliac artery ligation fails, there will be no access to uterine arteries for embolisation.<sup>12</sup>

Selective arterial embolisation developed from angiography to identify gastro-intestinal bleeding<sup>13</sup> and

subsequently to treat acute gastro-intestinal bleeding.<sup>14</sup> Urgent arterial embolisation has also been used to control intractable bleeding associated with pelvic trauma<sup>15</sup> and tumours.<sup>12</sup> The first reported use of transcatheter arterial embolisation in obstetric care was performed by Brown et al<sup>16</sup> in 1979. An angiogram helps to identify the bleeding sites, which appear as pools of contrast agent outside the vascular space (extravasation).<sup>16</sup> The examination however, should be performed selectively in the pathological vessel or in the uterine artery, even when no active bleeding is detected.<sup>9</sup> If the bleeding is continuous and severe, as in the case of atonic uterus, angiography may fail to detect the bleeding site.<sup>9</sup> Furthermore, if angiography fails to demonstrate extravasation and uterine arteries are very small and spastic, superselective cannulation of the uterine artery will not be possible, and embolisation of the internal iliac arteries will need to be done instead. This is an alternative technique permitting a shorter procedure with reduced radiation exposure.<sup>17</sup>

Gelfoam was used in our case series because it provides a temporary occlusion of the arterial bed for approximately 4 weeks. The Gelfoam pieces were about 2 to 4 mm in diameter. The vascular bed will eventually recanalise and allow the uterine vascularity to return to normal.<sup>5,18</sup> Other embolic materials available for occlusion include polyvinyl alcohol (PVA) particles and steel coils. These materials provide permanent occlusion of the vascular bed.<sup>19</sup> Coils may be particularly useful in occluding medium-sized vessels, but the disadvantage of this approach is that blood may flow through the coil; hence, bleeding may not stop immediately.<sup>20</sup>

One case of ischaemic uterine necrosis was reported by Cottier et al<sup>21</sup> after uterine artery embolisation with PVA particles (diameters, 150-250  $\mu$ m and 300-600  $\mu$ m) together with Gelfoam. Hysterectomy was finally performed because of pelvic pain, persistent menorrhagia, and infection. Histopathology of the uterus revealed massive ischaemic myometrial necrosis. The researchers concluded that the complication was more likely related to the small size of the particles used, and the material of choice for primary PPH is Gelfoam and small particles of alcohol should be avoided.<sup>21</sup>

In spite of that, PVA particles have been used by some investigators without any complications.<sup>9,22</sup> In a study by Pelage et al,<sup>9</sup> PVA was used alone successfully and without complications in four patients with life-threatening primary PPH. Hong et al<sup>22</sup> injected a long-term emboliser, PVA, followed by a short-term emboliser, Gelfoam, for uterine artery embolisation; no ischaemic complications were reported. In their study, Gelfoam was not used alone, because its temporary short-term effect could result in recanalisation and rebleeding. To prevent uterine necrosis, medium PVA particles (diameter, 250-355  $\mu$ m) were chosen rather than small ones. The important point is that particles of large diameter should be used to preserve the

smaller branches and collateral vessels. Further research on the efficacy of different embolic materials is required to determine the agent of choice.

In our study, arterial embolisation using Gelfoam was successful in immediately controlling bleeding in all cases. None of the patients in our case series required further embolisation or surgical treatment, except for the patient in case 2, who required a second operation to remove the abdominal packing. The patient in case 4 experienced mild numbness in her right-upper thigh when walking after the embolisation procedure. Duplex Doppler scanning confirmed narrowing of the right common iliac artery and showed that narrowing continued into the right external iliac artery. This narrowing is likely due to transient arterial spasm. The patient was treated conservatively and her symptoms gradually disappeared after a few weeks. In fact, this patient became pregnant 1 year after the embolisation protocol.

Although no major complications were encountered in our study, embolisation has some potential complications, such as haematoma formation at the site of catheter placement, infections and their effects (eg low-grade fever or pelvic abscess), contrast-related side-effects, and ischaemic complication.<sup>23</sup> Therefore, it is important that the coagulation abnormalities are corrected before embolisation to prevent a haematoma from forming after femoral artery puncture and to promote thrombosis in the uterine arteries after embolisation.<sup>3</sup> Neurological complications can arise because arterial communications exist between branches of the internal iliac artery and the spinal cord, sciatic nerve, and femoral nerve.<sup>24</sup> Complications were more common following the use of small embolic particles, such as those made of PVA, which caused permanent vascular occlusion.<sup>19</sup> Even if complications are minimal in skilled hands, the size and the number of emboli, as well as the type of material used for embolisation, may influence the safety of the procedure.<sup>17</sup>

In their post-procedural management, patients are recommended to be monitored for signs of ischaemic change, to keep fasting until their condition stabilises at reassessment, and to have the femoral artery sheath removed when the clotting profile has normalised. All patients were followed up regularly 2 weeks after discharge until the return of normal menstruation. In our case series, regular menstruation returned after embolisation for all eight patients who did not undergo hysterectomy, although with a reduced amount of menstrual bleeding during our short-term follow-up of up to 10 months. Collateral circulations help to maintain the tissue viability.

One woman became pregnant 1 year after embolisation but sought an abortion for social reasons. Studies have shown that fertility and pregnancy outcomes can vary after embolisation. Cordonnier et al<sup>25</sup> reported one case of foetal growth restriction in the next pregnancy after

uterine artery embolisation with Gelfoam for primary PPH. The histological examination of the placenta revealed a single umbilical artery and ischaemic necrosis in two thirds of placental villousities. The foetus had no malformation, and the patient had no relevant medical history or thrombotic risk that could account for the placental infarction. Possible explanations are that embolisation may cause chronic or permanent ischaemia or necrosis in small myometrial and endometrial areas. These ischaemic uterine areas may have vascular consequences on the placenta.<sup>25</sup> Stancato-Pasik et al<sup>26</sup> described a total of 12 patients who underwent selective gelatin sponge-induced embolisation of uterine vessels for obstetric haemorrhage. These patients were followed up for 1 to 6 years, and three of them conceived and had healthy newborns at term.

The obstetrician can help identify the patient who is at high risk of PPH and can administer preoperative (prophylactic) catheterization of the uterine or internal iliac arteries before delivery or elective surgery. In a non-randomised study by Mitty et al,<sup>18</sup> the role of prophylactic catheterization was evaluated in nine patients who were at risk of haemorrhage, especially in those with placenta praevia, placenta accreta, and abdominal ectopic pregnancy. Five of these patients did not require embolisation in the end, because the bleeding was controlled with the usual means. Only four of the nine patients underwent embolisation either before surgery (if the foetus was non-viable and had an increased risk of haemorrhage), or intra-operatively. In these five patients, the blood loss at surgery was much reduced. The study, however, is limited by the small sample and the non-randomised design.

Morbidly adherent placenta is one of the major causes of hysterectomy after failed embolisation, because of persistent bleeding.<sup>4</sup> Conservative management of placenta praevia percreta was reported as successful in two cases by Bennett and Sen<sup>27</sup> in 2003. In these two cases, the percreta was recognised antenatally and treated 'conservatively' by elective classical caesarian section and by leaving the placenta in situ. This procedure was followed by bilateral embolisation of the uterine arteries as a prophylactic measure for haemorrhage. Serial ultrasound scans demonstrated sequential degeneration of the placenta during the following months, with a return of normal menstrual cycles.

An additional way to manage severe primary PPH due to morbid placental adherence was reported by Johanson et al<sup>28</sup> in 2001. Urological hydrostatic balloon catheters were inserted into the uterus in two cases of intractable vaginal bleeding following manual removal of a morbidly adherent placenta or succenturiate lobe. The balloons were inflated with 400 to 500 mL of normal saline, and the catheters were removed 24 hours later with no evidence of further bleeding. Further surgical interventions were avoided. The authors emphasised that the procedure is easy to perform and may have a lower risk of infection. A

larger study is required to assess the efficacy of hydrostatic balloon catheterization in the management of massive primary PPH.

A prospective study comparing the efficacy of different embolic materials would reveal the agent of choice, however, such a study may take a long time to complete, because the patient samples are usually small. In addition, studies of the effects of embolisation on menstruation, fertility potential, and subsequent pregnancy outcome are limited by short-term follow-up duration. Longer follow-up periods are needed. The role of prophylactic arterial catheterization in pregnant patients who are at high risk of bleeding also needs to be explored.

## Conclusion

Massive obstetric haemorrhage remains a significant cause of maternal morbidity and mortality. With the high success rate, relative low complication rate, and preservation of fertility potential, arterial embolisation should be considered as the treatment of choice for intractable primary PPH.<sup>8</sup> Embolisation also avoids the morbidity associated with surgery. However, it requires a multidisciplinary approach, as well as rapid and good communication between different specialties. Further research with longer follow-up durations is required to determine the embolic agent of choice, the place of prophylactic arterial catheterization in high-risk patients, and the potential effects after embolisation on menstrual pattern, fertility, and pregnancy outcome.

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