To analyze uterine arteriographic features of patients with uterine myomas and adenomyosis that might facilitate transcatheter uterine artery embolization (UAE).

Seventy-eight uterine arteriograms of 44 consecutive patients (mean age 38.8 year-old ± 6.8) (32 with uterine myoma, mean age of 38.6 ± 6.7 and 12 with uterine adenomyosis, mean age of 39.2 ± 7.1) treated with transcatheter uterine artery embolization were retrospectively reviewed by 2 radiologists in consensus. Ten uterine arteriograms were excluded because of poor diagnostic quality or incomplete visualization of uterine artery origins. The indication for UAE was symptomatic patients who refused or were not suitable for traditional surgery. UAE was performed via bilateral common femoral approach using two angiographic catheters. Simultaneous angiographic studies of both internal iliac arteries in AP, bilateral 25-degree oblique projections and selective uterine artery studies only in AP projections were obtained by injecting contrast medium into two angiographic catheters linked by a “Y” luer-lock connector. The arteriographic features thought relevant to UAE were the incidence of a typical “U” course, the radiographic projection that best demonstrated the origin of uterine arteries from internal iliac artery, and the average size of the uterine artery measured at the descending segment.

Our analysis showed that the origin of uterine artery was best visualized in contralateral 25-degree oblique projection in 67% (52 of 78) arteriograms, ipsilateral anterior oblique in 17 % (13 of 78) and straight A-P in 17%. The classic “U” configuration occurred in 100% of uterine arteries. The average size of the uterine artery at the descending segment measured 2.9 mm for uterine myomas and 2.4 mm for uterine adenomyosis. Selective catheterization of the uterine artery was successful in 87% of cases using a 4.2-French Shepard hook angiographic catheter (equivalent to 1.4 mm in outer diameter). Transient uterine artery spasm occurred in 13% of uterine arteries (10 of 78) with all but one could be relieved by intra-arterial injection of 25 µg of nitroglycerin. Microcatheter was used in 17% (6 of 44) of patients, but all during our early experience. Uterine artery embolization was technically successful in 100% of our patients and no miscannulation of arteries other than the uterine arteries was noted.

Our study revealed that a proper knowledge on the typical uterine arteriographic features facilitated proper and safe performance of transcatheter uterine artery embolization.

Key words: Uterine artery, Arteries, Therapeutic Embolization; Uterine neoplasms; Leiomyoma; Adenomyosis

Uterine artery embolization has become an alternative treatment for uterine fibroids because of its high successful rate ranging 84-92% for menorrhagia, 74-79% for control of dysmenorrhea and 76% for bulky symptom relief [1-5]. This relatively new treatment for uterine fibroid is practiced in many parts of the world with high patient satisfaction and a low complication rate of 1-2% [1-5].

In Taiwan, the available centers for uterine artery embolization for uterine fibroid is limited because of a
dominant gynecologic practice and gynecologists’ boycott [6]. As a result, the interventional radiologists in Taiwan in general may be less familiar with the angiographic features relevance to superselective uterine artery embolization in this setting.

Without a proper knowledge on the pertinent uterine arterial anatomy, inadvertent embolization of adjacent organs such as vagina and urinary bladder can occur by mistake [7-9]. In this paper, we report the angiographic features of uterine artery relevance to selective uterine artery embolization by retrospectively review of our 44 patients treated for symptomatic uterine fibroid and adenomyosis.

**MATERIALS AND METHOD**

We retrospectively review the angiograms of 46 consecutive patients (mean age 38.8 ± 6.8, range 22-53 years) who underwent selective uterine artery embolization for symptomatic uterine fibroid (32 patients) and adenomyosis (12 patients) during a 17-month period from April 2000 to September 2001. Two patients were excluded because their angiograms were of suboptimal quality for the purpose of this study. During the course of the study, another 10 uterine arteriograms were further excluded either because their origins were not well delineated or the uterine artery size at the level of their descending segments could not be measured. The resulting seventy-eight uterine arteriograms were the subject of this review. The uterine arteriographic features such as its course, the best radiographic projection of its origin from internal iliac artery and its average size were analyzed by 2 radiologists by consensus.

The indications for uterine artery embolization were menorrhagia with anemia, dysmenorrhea which were poorly controlled by analgesics, bulky symptoms such as frequency or palpable lower abdominal mass or refused hysterectomy. Ninety percent of our patients were self-referral. Our patients came to us after obtaining information on uterine artery embolization from the newspapers or our web site. Three gynecologists referred 4 patients who either refused hysterectomy offered to them or asked for uterine artery embolization. Patients’ presenting symptoms and signs such as dysmenorrhea, menorrhagia and uterine fundal height were recorded. Pre-procedure blood tests including hematocrit, hemoglobin, white blood differential count, serum creatinine and blood coagulation profile. Patients were diagnosed to have adenomyosis by severe dysmenorrhea during menstrual period and uterine myoma by sonographic finding of well circumscribed masses. All the above tentative clinical diagnoses were confirmed by MRI without and with gadolinium contrast enhancement before and 6-months post-embolization [6].

**Uterine Artery Embolization Procedure**

Every patient received a Foley catheterization before the procedure. Prophylactic antibiotic (500 mg cephamexin) was given in an intravenous bolus 30 minutes before the embolization procedure began.

**Figure 1.** A 36-year-old female of adenomyosis bothered by severe dysmenorrhaiga and vagina spotting. Her uterine arteriogram on simultaneous contrast injection into bilateral uterine artery (a. arrows). Right anterior oblique (RAO) projection (i.e. contralateral RAO) of the x-ray clearly identified the contralateral left uterine artery orifice (b. arrow) and left anterior oblique projection well demonstrated the contralateral right uterine artery (c. arrow).
Bilateral common femoral artery approach as described by Nikolic et al [10] was used as the method reduced procedure time, radiation dose and facilitated Ivalon injections by two radiologists simultaneously. Both groins were sterilized with 10% Povidine iodine solution and covered with sterile drapes. The groins were covered with a 10 × 12 cm Tegadem (3M Health Care, St. Paul, MN, USA). Bilateral common femoral arteries were accessed using the 18-gauge intracatheter needle (BD Insyte, Infusion Therapy Systems Inc, Sandy, Utah, USA) and with two 5- French vascular sheaths. Subsequent to the insertion of a 0.035-inch guide wire (Terumo Corporation, Tokyo, Japan), a 4.2-French Shepard-hook type 1 (Goodtec Co Ltd, Gifu, Japan) angiographic catheter was inserted from the common femoral artery into the proximal segments of the contralateral internal iliac artery. A similar angiographic catheter was inserted from the other common femoral artery again into proximal segment of contralateral internal iliac artery with a crossover at distal abdominal aorta. The angiographic catheters were connected by a “Y” luer-lock connector and then to a power injector for simultaneous injection of contrast medium. The angiograms were obtained using the Multi Diagnost 4 (Phillips Medical Systems, DA, Netherlands). Calibrated measurement of the size of uterine artery was done by using the 4.2-French angiographic catheters. For simultaneous bilateral internal iliac arteriography, ionic iodinated contrast (Conray 60%, Mallinckrodt Canada Inc, Quebec, Canada) was injected at a rate of 6 mL per sec for a total of 12 mL. Straight anterior-posterior (AP), a fixed 25-degree bilateral oblique views (Fig. 1a, 1b, 1c) which permit evaluation of orifice of the uterine artery from different angles were obtained. The view (AP or oblique) that best showed the orifice of uterine artery was selected for a road-map instant angiogram. Under road-map guidance, selective catheterization of uterine arteries using the 4.2-French angiographic catheters down to their horizontal segments were done (Fig. 2). Occasionally, a microcatheter was used for selective catheterization when a small uterine artery, a very tortous horizontal segment or easy spasm was noted. With the catheters tip at the horizontal segments of uterine arteries, iodinated contrast was injected at 4 mL per sec for a total of 8 mL and bilateral uterine arteriograms were obtained only in AP projection to confirm the final position of catheters in preparation for embolization. This served as a pre-embolization control angiograms. Ivalon particles measuring 400-600 µm in size (Ultra-Drivalon, CathNet-Science, Paris, France) were injected simultaneously via bilateral angiographic catheters, separately by two radiologists until stasis of the blood flow noted in the uterine arteries. At completion, a final post-embolization angiogram performed by power injector was taken in AP view using a slightly reduced contrast dosage to prevent reflux of Ivalon particles. The end-point of uterine artery embolization was complete obliteration of uterine stain under subtraction angiography. The average Ivalon used per patient was 300 mg (3 bottles). The angiographic configuration and course of the uterine arteriograms were analyzed. The view that best demonstrated the orifice of the uterine artery was selected. The calibers of uterine arteries were measured at the descending segment, 3cm from their origin, by two radiologists. The total procedure time was recorded.

Statistical Evaluation

The percentage of angiographic projections that best demonstrated the uterine artery origins was calculated and their relative frequency were tested using Chi-square test (Table 1). The size of descending segment of uterine artery was measured and the difference of uterine arterial size in patients with uterine myomas or adenomyosis was evaluated using Student t-test (Table 2).

RESULTS

Uterine arteries could be identified by their char-
uterine or myoma stains on delay images. Course of ascending segment of uterine artery and the uterine arteries include the classic tortuous undulating characteristic U-configuration, which comprised of the descending, horizontal and ascending segments and the intramural arcuate arteries. The orifices of uterine arteries as they branched off from the internal iliac artery were best recognized and separated on contralateral anterior oblique 25-degree projection in 67% (52/78) (Figure 1b,c), ipsilateral anterior oblique 25-degree projection in 17% (13/78) and straight AP projection in 17% (13/78) (Table 1). The mean size of the uterine artery was 2.4 ± 0.4 mm for patients with uterine adenomyosis and 2.9 ± 0.8 mm for patients with uterine myomas (Table 2). The cervicovaginal branch supplying the upper vagina was visible in 8% (6/78) and the ovarian arteries were recognized in 3% (3/78) of post-embolization angiograms.

Microcatheters were used in 6 patients (17%, 6/44) with uterine myomas; five of the 6 patients in whom microcatheter were used in the early part of our study. No microcatheter was used during the later part of our embolization for both uterine myomas and adenomyosis.

**DISCUSSION**

A U-shape course is a characteristic of uterine arteries. This feature facilitates its differentiation from the vesicle and internal pudendal arteries which have a similar course but do not show the typical “U” course. Other salient features that permit recognition of the uterine arteries include the classic tortuous undulating course of ascending segment of uterine artery and the uterine or myoma stains on delay images.

We describe a simple and useful technique of identifying the uterine artery by contralateral oblique projection (25°). Simultaneous demonstration of bilateral uterine arterial orifices may also be obtained using rotating angiography, however, a more dedicated angiographic machine is needed. The standard nomenclature of angiographic projections is sometime confusing to the radiologist because the X-ray source is at the buck and image intensifier is in front of the patients. The widely accepted method suggested by Paulin S [11] is adopted here. Using this classic nomenclature, a contralateral anterior oblique view of left uterine artery is taken by rotating the image intensifier towards right anterior aspect of a patient’s pelvic cavity. The road-map angiography is obtained at the same projection that best demonstrates the origin of uterine artery to facilitate its selective catheterization under fluoroscopic road-map guidance. In Pelage series [12], the uterine artery is also best seen in the contralateral anterior oblique view taken at 25-degree. In our experience, road-map fluoroscopic-guided selective catheterization of bilateral uterine arteries for the purpose of UAE shortens procedure time and may potentially reduce radiation exposure both to the patients and the radiologists. To avoid misplacement of angiographic catheter into a mistaken branch arising from the internal iliac artery, the radiologist must aware of a number of normal variations how the uterine artery branches from the internal iliac artery [12]. In Pelage series [12], the internal iliac artery can have two, three, and four main stems that subsequently branch into the visceral and parietal branches which supply the various regions of the pelvic cavity [12].

The uterine artery as a branch arises from the anterior division of internal iliac artery is most frequent [12-14]. The vesicle arteries (superior and inferior) and the vaginal artery appear to take a similar course as the uterine artery in their initial paths along the pelvic side wall but they do not have the classic undulating tortuous upward bend and uterine stains at late phase. Our experience indicates that collapsing the urinary bladder by an indwelling Foley catheter may assist identification of the vesical arteries to avoid its mis-embolization [8,9]. Selective catheterization up to the ascending segment of the uterine artery was commonly recommended by most who performed uterine artery embolization for uterine myomas [1-5]. It was hoped that the cervicovaginal artery which commonly arises from the horizontal segment could be avoided to prevent an excessive embolization causing upper vagina necrosis [8]. However, transcatheter uterine artery embolization performed by parking an angiographic catheter at the horizontal segment was

### Table 1. The radiographic projection that best identify the uterine artery (UA) orifice

<table>
<thead>
<tr>
<th>Radiographic projections</th>
<th>Optimal demonstration of UA orifice</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contralateral 25-degree oblique&lt;sup&gt;a&lt;/sup&gt;</td>
<td>67% (52/78)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Ipsilateral 25-degree oblique&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17% (13/78)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Anterior posterior</td>
<td>17% (13/78)</td>
<td>&lt; 0.05</td>
</tr>
</tbody>
</table>

<sup>a</sup> Chi-square test  
<sup>b</sup> The oblique projections (either in RAO or LAO) were taken at a fixed 25 degrees which aimed at both uterine arteries. A contralateral oblique projection meant that the image intensifier was pointing away from the uterine artery which was best demonstrated in that projection.

### Table 2. Uterine artery size in relation to uterine pathology

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Mean size (mm)</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenomyosis (n=12)</td>
<td>2.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Uterine myoma (n=32)</td>
<td>2.9</td>
<td>&lt;0.05</td>
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</tbody>
</table>

* Student t-test  
<sup>*</sup> The uterine artery size was measured at the descending segment, 3cm from its origin. Two measurements were made at each projection in RAO, LAO, AP views of bilateral internal iliac arteriography.
safe in our experience provided there was free-forward flow of embolizers. It was of practical value to avoid vasospasm because the therapeutic effect on uterine myoma for unilateral embolization was ineffective [15].

In UAE, a microcatheter is often recommended by most authors to avoid arterial spasm which occurred in 13% of our cases. However, a microcatheter is expansive and increases the cost of UAE [16, 17] when MRI and secondary assisted gynecologic surgery are added together. A radiologist should think of a cost-down competitive pricing when faces opposition from the gynecologists. One of the way we have taken is to use the microcatheter when the artery is small and has a very tortuous horizontal segment. Our data indicates that the average uterine artery size at the descending segment measured 2.9 mm for patients with uterine myomas and 2.4 mm for patients with uterine adenomyosis. This may explain a high successful rate in selective catheterization of uterine arteries using an ordinary 4.2-French diagnostic angiographic catheter (equivalent to 1.4 mm). However, transient vasospasm occurred in 13% of uterine arteries (10 of 78) and all but one could be relieved by intra-arterial injection of 25 μg of nitroglycerin. Embolization for this patient was completed via the prominent collaterals from contralateral uterine artery. However, this patient experienced a 50 % reduction in uterine myoma size which was modest and within the range of 34-50 % of expected myoma shrinkage [18]. With experience, UAE may be done without using a microcatheter in most instances. In our experience, microcatheters were used in 11% (6 of 44) of patients all during our early experience. In later part of our study, most UAE were accomplished without using a microcatheter. However, extremely careful use of a fluoroscopic road-mapping in selective catheterization of the uterine artery to prevent arterial spasm is recommended.

In this study, we did not routinely perform aortography to look for the ovarian arteries which arise from abdominal aorta below the renal artery at L2 level, because an extra arteriographic study increases patient’s radiation dose. However, when a myoma which has a perfusion defect noted during selective uterine arteriography or in post embolization film of the contrast-filled uterus, then further search of a parasitic blood supply from the ovarian artery is mandatory to avoid poor shrinkage of the myoma [19].

In conclusion, our study on uterine arteriographic features relevance to UAE is helpful in guiding less experienced radiologists during selective catheterization and embolization procedure. Proper angiographic knowledge shortens procedure time and reduces radiation dose to patients and radiologists.

REFERENCE


子宮動脈栓塞時之子宮動脈特徵

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對子宮肌瘤與腺瘤的經動脈栓塞，擁有很高的成功率。在國外已是手術外的另一種替代性治療。了解子宮動脈的解剖特性，對子宮肌瘤與腺瘤的經動脈栓塞，有很大的幫助。

我們收集共有44個病人，由兩側股動脈同時進入檢查。採三種不同的角度攝影。正面直像，同側25度斜像，對側25度斜像，用Y型管以同時攝影。利用子宮動脈的U型特性，以認定子宮動脈開口，分析子宮動脈管腔大小。將導管置放在子宮動脈横向部，以永久性顆粒栓塞劑，將子宮動脈塞滿。此研究結果發現，對側25度斜像，最易於認定子宮動脈開口；對於大多數的子宮動脈栓塞，4.2 Fr的導管，常可勝任。

關鍵詞：經導管動脈栓塞；子宮肌瘤；子宮腺瘤