Résumé
Embolsation artérielle utérine par matériel résorbable avant myomectomie
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Objectifs. Les fibromes représentent une cause fréquente de consultation en gynécologie. La myomectomie est une alternative thérapeutique conservatrice. Le principal risque de cette intervention tient à son caractère hémorragique. L'objectif principal de cette étude est de montrer l'efficacité de l'embolsation transitoire des artères utérines pour diminuer les pertes sanguines et simplifier la myomectomie. Les objectifs secondaires sont d'évaluer la morbidité et la fertilité ultérieure.

Patients et méthodes. Il s'agit d'une étude rétrospective descriptive de vingt et un cas d'embolsation utérine avant myomectomie sur une période de 3 ans au Centre Hospitalier Universitaire de Dijon.

Résultats. La myomectomie après embolsation avec du matériel résorbable est quasiment exsangue. Les moyennes des taux d'hémoglobine en pré et postopératoire sont comparables (p < 0,0001). La suture utérine est techniquement plus simple. Le nombre de fibromes retirés (p = 0,2824) et la présence d'une anémie avant l'intervention (p = 0,474) ne modifient pas de manière statistiquement significative la durée d'hospitalisation. Trois patientes ont présenté des synéchies postopératoires dont la cure a été simple. Deux patientes ont pu mener à terme une grossesse spontanée.

Conclusion. L'embolsation transitoire a permis de limiter les saignements. Cette technique mixte diminue le risque d'hystérectomie et les complications liées aux hémorragies (hématome, infection, fragilité de la cicatrice). Elle doit être utilisée chez des patientes qui souhaitent conserver leur utérus lorsque le risque hémorragique est élevé. Son utilisation doit être évaluée de façon très précise chez des patientes qui souhaitent conserver leur utérus lorsqu'elle est simple. Deux patientes ont pu mener à terme une grossesse spontanée.


Abstract
Purpose. Fibroids are a frequent cause of gynecology referral. Myomectomy is a conservative treatment alternative. The main risk from this procedure is hemorrhage. The main objective of this study was to demonstrate the efficacy of preoperative uterine artery embolization with resorbable agents to reduce blood losses and facilitate myomectomy. Secondary objectives were to evaluate morbidity and subsequent fertility.

Patients and methods. Retrospective study of 21 patients with preoperative uterine artery embolization prior to myomectomy at the University Medical Center of Dijon over a 3 year period.

Results. Myomectomy after uterine artery embolization with resorbable agents was associated with only minimal blood loss. Mean preoperative and postoperative hemoglobin levels were comparable (p=0.0001). Uterine suturing was technically simpler. The number of resected fibroids (p=0.2824) and the presence of preoperative anemia (p=0.474) had no statistically significant impact on the duration of hospital stay. Uterine synecchiae occurred in three patients after the procedure, and were easily treated. Two patients had normal subsequent pregnancies.

Conclusion. Preoperative uterine artery embolization with resorbable agents was effective in reducing surgical blood losses. This technique reduces the number of hysterectomies and hemorrhagic complications (hematomas, infection, weaker scar tissue). It should be considered in patients wishing uterine preservation when the hemorrhagic risk is high. Its use in patients seeking subsequent pregnancy should be further assessed with larger series.

Key words: Fibroid. Arterial embolization. Gelatin. Myomectomy.


uterine fibroid is the most frequent benign tumor in women of child-bearing age. Surgical management may be conservative when possible (myomectomy) or radical (hysterectomy) in some cases. Selection of the appropriate surgical option may be delicate at times especially for women of child-bearing age that wish to preserve their fertility or perceive radical surgical management as the equivalent of mutilation. However, the hemorrhagic risk and technical difficulties of the surgical procedure sometimes make hysterectomy a preferred option. Also, even when conservative surgery is selected, the patient must be informed of the potential need for hysterectomy, which may create much anxiety. Based on the good experience in the management of postpartum hemorrhage, uterine artery embolization (UAE) has been used since 1989 for treatment of symptomatic fibroids, with much advances since 1995 (1-4). UAE prior to myomectomy was first described by Ravina in 1994 (1, 2). The principle is based on occlusion of the vascular supply to the fibroid prior to conservative surgical management. The procedure was described on the principles of temporary presurgical embolization. Even though Ngeh, et al. (5) reported in 2004 that the technique was valuable to reduce surgical blood losses, only few series assessing the value of the technique are available. The primary purpose of this study is to demonstrate the efficacy of preoperative UAE to reduce blood losses and facilitate myomectomy. Secondary purposes were to evaluate morbidity and subsequent fertility.

(1) Service de Gynécologie-Obstétrique, Médecine Fœ-tale et Sénilité Congénitale, BP 77998, 21079 Dijon Cedex.
(2) Département de Radiologie et d’Imagerie Médicale Diagnostique et Thérapeutique, Centre Hospitalier Universitaire, Dijon.
Correspondence: H Tixier, 37, rue Sambin, 21000 Dijon.
E-mail : herve_tixier@yahoo.fr

Patients and methods

Retrospective study over a three year period, from December 2001 to December 2004, from cases referred to the Imaging Department and Gynecology Department of the University Medical Center of Dijon. Twenty-one patients with uterine fibroids preferring conservative management underwent UAE with resorbable agents prior to myomectomy.

Preoperative work-up of uterine fibroids

All 21 patients underwent pelvic US and MRI. Transabdominal and transvaginal US was performed. US allowed: mapping of fibroids: location (subserosal, intramural, submucosal, isthmic, body, fundal, anterior, posterior), distance to uterine mucosa, size, relationship with surrounding structures; evaluation of vascularity with color Doppler US: peripheral arterial flow, lateralization of the feeding artery; evaluation of adnexae, and detection of associated conditions; create a diagram summarizing the findings.

MRI evaluation was performed using standard protocol on a 1.5 Tesla unit (Magnetom Vision, Siemens Medical Systems, Erlangen, Germany): axial, sagittal and coronal TSE T2W sequences, precontrast and postcontrast fat-suppressed GRE T1W sequences with dynamic acquisitions at 0, 30, 60 and 90 seconds in the sagittal plane following IV injection of 15 ml of gadolinium (Dotarem®; Guerbet, Roissy CdG, France), then at 3 minutes in the axial plane using 5 mm thick slices. The purpose was to assess the uterus, cervix and adnexae to exclude the presence of suspicious lesions. The exact location of fibroids (subserosal, submucosal, intramural, fundal, anterior, posterior), their location relative to the endometrial cavity, their size in all three planes, the homogeneity of their signal intensity, their hypervascular nature and enhancement dynamics were recorded. The hypervascularity of the fibroid or fibroids was considered favorable for embolization. The size of the uterus in all three planes was also recorded. Finally, an alternate pathology could sometimes be detected on MRI (differential diagnosis).

Surgical indications

UAE was performed prior to surgery in cases where the hemorrhagic risk was considered higher: need for multiple myomectomies, large fibroids (> 5 cm), patients declining blood transfusions. A multidisciplinary committee composed of radiologists and surgeons reviewed all cases. Detailed information about advantages and pitfalls of the different therapeutic options were provided to the patients. Irrespective of the surgical technique, the main indication for preoperative UAE was for large fibroids. We believe that the hemorrhagic risk in that situation is highest, including during laparotomy, increasing significantly the risk for hysterectomy. This combined approach was preferred for patients with multiple fibroids, with 1 or 2 fibroids > 5 cm in size. However, permanent UAE using non-resorbable particles was usually preferred for patients with multiple fibroids < 5 cm in size without dominant large fibroid. The discussion also included data about fibroid location: intramural and submucosal fibroids were considered whereas subserosal fibroids were excluded. The fibroid to endometrial distance was assessed to avoid transgression.

UAE technique

A right or left transfemoral approach allowed selective catheterization of the anterior division of the right and left internal iliac arteries with a standard 5F catheters. An initial angiogram was performed to assess the anastomotic peritumoral vascular network and exclude potential utero-ovarian anastomoses. The bilateral uterine arteries were then selectively embolized with manually cut resorbable Curaspon® (Curamedical, Amsterdam, Netherlands) gelatin particles until complete occlusion. Post-embolization angiograms confirmed successful devascularization (fig. 1). Patients were admitted to the surgical gynecology department the day prior to UAE. They received pain management based on a protocol established by anesthesiologists and radiologists. The protocol was initiated 20 minutes prior to being called to the embolization suite and included IV administration of painkillers, anti-spasmodic and anti-inflammatory medications. It was maintained post-UAE and complemented when needed with a morphine pump (morphine 1 mg/ml + Droleptan 2.5 mg in 50 ml) with rate adjusted based on respiratory rate and severity of pain determined from a visual analog scale.

Myomectomy technique

Myomectomy was performed in the hours following UAE (fig. 2). The type of
surgical approach was selected based on the location and size of the fibroids, the patient’s previous medical history and the surgeon’s experience.

Patient follow-up and postoperative complications

All immediate postoperative complications were recorded. The amount of surgical blood loss was determined by comparing preoperative hemoglobin level with the hemoglobin level obtained 48 hours after surgery. All patients were followed-up by the surgeon at one month. For patients wishing to become pregnant, an outpatient hysteroscopy was performed at 3 months to confirm the absence of postoperative synechiae.

Statistical analysis

To compare mean hemoglobin levels, the Shapiro-Wilk test was performed to confirm the Gaussian or normal distribution of the variable. A parametric t-test (Student) was performed for matched samples. A patient requiring management of significant blood loss was excluded from this evaluation. The Mann-Whitney test was used to assess the impact of specific variables on the duration of hospital stay.

The probability for a type I error was set at 5%.

**Results**

**Patient characteristics**

The mean patient age was 37 years, with range from 27 to 42 years. The median number of gestation was 0, with range from 0 to 2. The median parturition was 0 delivery, with range from 0 to 2. Ten patients expressed a desire for future pregnancy prior to the procedure.

**Surgical indications**

Eight patients (38.1%) presented menometrorrhagia with anemia from iron deficiency in 4 cases. One of these patients was treated emergently for severe menometrorrhagia and acute anemia (Hb: 5.7 g/dl). Eight patients (38.1%) presented pain. Three of these patients had one or more prior episodes of fibroid necrosis, while the other five patients (23.8%) complained of pelvic heaviness. Two patients (9.5%) presented symptoms of urinary bladder of bowel compression. Three patients (14.28%) were asymptomatic but wished to become pregnant.

**Embolization technique**

All UAE procedures were successful, with no case of technical failure.

**Fibroid characteristics, surgical approach, length of surgery, and intraoperative complications**

All fibroids were intramural in location except for one case of broad ligament fibroid. Ten patients (47.6%) had a polymyomatous uterus. In these patients, the largest fibroid was always larger than 5 cm in diameter. Eleven patients (52.4%) had a single large fibroid. Mean fibroid size was 10 cm, with a range of 4 to 15 cm. Sixteen patients underwent laparotomy for removal of 2.19 (1-8) fibroids on average with mean diameter of 16.33 cm (+29 cm). For size calculations, the sum of the largest diameter of each resected fibroid was used for polymyomectomies. Mean operative time was 95 minutes (53-150 min). Five patients underwent laparoscopy for removal of 1.92 (1-3) fibroids on average with mean diameter of 12.75 cm (5-14 cm). Mean operative time was 176 minutes (90-260 min). Blood losses at the time of surgery were minimal allowing optimal uterine suture. A single intraoperative complication was recorded: 4 cm lacera-

**Postoperative complications**

The following complications were recorded

- a patient (4.7%) presented with bowel obstruction from adhesions at 8 months requiring surgical management;
- three patients (14.28%) desiring pregnancy showed evidence of synechiae at follow-up hysteroscopy performed at 3 months. These could be lysed at flexible hysteroscopy in two cases and surgical hysteroscopy was required in one case;
- one urinary tract infection at day 5;
- single episode of fever at 24 hours with spontaneous resolution;
- one case of pre Delirium Tremens.

**Blood loss**

Only the patient presenting acutely with severe menorrhagia and anemia required blood transfusion. She was given 3 units of packed red blood cells during surgery. Preoperatively, the mean hemoglobin level was 12.78 g/dl with a median of 12.85 g/dl and standard deviation of 1.08. Postoperatively, the mean hemoglobin level was 11.19 g/dl with a median of 11.2 g/dl and standard deviation of 0.934. Mean hemoglobin levels before and after surgery were comparable (p<0.0001).

**Duration of hospital stay**

The mean duration of admission was 8 days, with a range of 5 to 11 days. The duration was not affected by the presence of preoperative anemia (p=0.474) or the removal of several versus a single fibroid (p=0.2824).

**Subsequent fertility**

Two of 10 patients (20%) wishing to become pregnant prior to surgery were able to successfully bring a normal spontaneous pregnancy to term. They underwent prophylactic C-section at 36 weeks GA to reduce the risk of uterine rupture.
Discussion

As previously demonstrated by Ravina in 1995 (1-3), this combined approach is of value for patients with high hemorrhagic risk: polynymoectomies, single large fibroid (>5 cm) and for patients declining to receive blood transfusions. Preoperative embolization allows surgery with only negligible blood loss as indicated by the absence of significant change between preoperative and postoperative hemoglobin levels. Fibroids are supplied by an anastomotic network of uterine vessels. The uterine arteries usually are enlarged. Peripheral arterial flow develops around the fibroids and is the target of UAE. Specific control of fibroid vascularization is important, especially for laparoscopic procedures. Surgical dissection is facilitated, a significant advantage for fibroids contacting the endometrial cavity. Also, uterine suturing is performed in optimal conditions, with complete hemostasis. The risk of complications at the level of the uterine surgical site (synechiae, adhesions, weakness) is thus reduced. Our results will probably be further improved by promoting a laparoscopic approach. Indeed, the level of technical complexity of the procedure is reduced by the absence of hemorrhage. This minimally invasive technique provides faster postoperative recovery, with reduction in postoperative adhesions and probably is associated with improved fertility preservation. Over time, we have progressively reduced the time delay between UAE and surgery. Initially, patients were operated at 48 hours, then 24 hours, and currently only 3 hours after embolization. As previously reported by Ravina and Benifla (1, 2), we have also noted that early surgery was associated with reduced pain from post-UAE fibroid necrosis, reduced rate of postoperative adhesions and preserved surgical planes of dissection. When conservative management is possible, several therapeutic alternatives must be discussed in the setting of a multidisciplinary group. Permanent embolization with non-resorbable particles must only be performed in patients with multiple fibroids that would require multiple surgical incisions resulting in weakness and complications. The size and distribution of fibroids did not appear to be significant criteria. However, the rare potential complication of septic necrosis requiring hysterectomy mandates that this procedure should be used with caution in patients wishing a fertility-preserving procedure. Series have been published describing the long-term results from UAE with resorbable particles (6, 7) with satisfactory symptomatic outcome. With regards to fertility, the pregnancy rate was 5/10 but post embolization synechiae were frequent (4/7) (6). Also, in patients wishing to become pregnant, Goldberg (8) reported in 2006 that myomectomy should be preferred over definitive UAE. In addition, Mara (9) confirmed that both definitive UAE and myomectomy provided similar results for symptomatic relief but that the pregnancy rate was higher in the first two years post myomectomy. In patients wishing to become pregnant, the purpose of the treatment is double: uterine preservation and improved fertility. The value of embolization using resorbable gelatin particles is that the vascular territory is reperfused within a few days to a few weeks, making the procedure safer. The risk of complications, especially ischemic, during the procedure are reduced compared to the use of non-resorbable particles leading to permanent vascular occlusion. The resorbable particles also are advantageous due to their lower cost and ease of use. Therefore, preoperative UAE would reduce the risk of radical hysterectomy. Myomectomy would improve the rate of subsequent pregnancy. The combined approach thus provides a good compromise. In addition, the risk of septic necrosis with the combined approach is avoided by the subsequent myomectomy. The incidence of synechiae appears acceptable especially since they tend to be partial and easily managed. A follow-up hysteroscopy should however be performed at 3 months. Our results should be confirmed with larger prospective studies. It would also be valuable to determine the efficacy of transient embolization on non-resected fibroids.

Conclusion

The combined approach is advantageous for reducing peroperative blood losses by resulting in only negligible bleeding at the time of surgery. The risk of radical hysterectomy and hemorrhagic complications are reduced. Surgery should be performed soon after embolization, within 3-4 hours. The technique appears ideal for women with high hemorrhagic risk desiring a fertility-preserving procedure: large single fibroid, multiple fibroids or patients declining blood transfusions.

References