



Clinical recommendations on the use of uterine artery embolisation (UAE) in the management of fibroids

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1. Summary of recommendations

1. The early- and medium-term (to five years) results of uterine artery embolisation (UAE) are good. It is as effective as surgery for symptom control, with the caveat that about a third of women will require a second intervention by five years.
2. For women with symptomatic fibroids, UAE should be considered as one of the treatment options alongside surgical treatments (such as myomectomy and hysterectomy), endometrial ablation, medical management and conservative measures.
3. The evidence for fertility and pregnancy outcomes after UAE and after myomectomy is poor. Similarly there is no robust evidence *comparing* UAE or myomectomy for these outcomes. Currently, it is impossible to make an evidence-based recommendation about treatment (UAE or myomectomy) for women with fibroids who wish to maintain their fertility. Treatments for fibroids in women of childbearing age who wish, or might wish, to become pregnant in the future should be offered only after fully informed discussion.
4. The procedure is contraindicated in women who have evidence of current or recent pelvic infection, who are pregnant, who are not prepared to accept the small risk of the requirement for hysterectomy in the event of complication or in whom there is significant doubt about the diagnosis of benign pathology.
5. Patients for UAE should be selected and assessed by a multidisciplinary team including a gynaecologist and an interventional radiologist. Direct referral from primary care to an interventional radiologist is acceptable, although local governance arrangements should ensure gynaecology input into the management of patients referred in this manner. Accurate pretreatment diagnosis with MRI is recommended.
6. The procedure should only be undertaken by radiologists with established competence in embolisation techniques who have undergone appropriate training.
7. The responsibilities of both gynaecologist and radiologist for the care of the patient should be established prior to treatment and be set out in a relevant hospital protocol. The patient must be under a named responsible consultant at all times – this could be a radiologist or a gynaecologist (or both). Comprehensive follow-up protocols should be established. This should include contact telephone numbers for advice after discharge from hospital.
8. These recommendations are intended for both the National Health Service and the private sector.

2. Introduction and background

Arterial embolisation has been used during the last three decades as a method of treating gynaecological haemorrhage in a variety of clinical situations, including postpartum haemorrhage, bleeding after caesarean section and bleeding following gynaecological surgery. The technique was subsequently used for the management of arteriovenous malformations of the genital tract and in gestational trophoblastic disease. Ravina *et al* first used arterial embolisation to treat fibroids in 1991, publishing their series in 1995.¹

In 2000, a Joint Working Party of the Royal College of Obstetricians and Gynaecologists and The Royal College of Radiologists was established to issue guidance on uterine artery embolisation (UAE) – a procedure which at that time was in its infancy with fewer than 7,000 cases undertaken worldwide. Since the publication of this guidance, the procedure has become well established and over 100,000 cases have now been performed worldwide. The evidence from

national registries and randomised trials has demonstrated that UAE has good short- and medium-term success rates with acceptable morbidity and very low mortality.

The procedure is now a widely accepted option for the treatment for symptomatic fibroids and has been recognised as such by the National Institute for Health and Care Excellence (NICE) in its guideline for heavy menstrual bleeding.²

Clinical recommendations on the use of uterine artery embolisation in the management of fibroids, Third edition is intended to provide information for patients interested in undergoing UAE and guidelines for clinicians involved in their care. It replaces previous advice given in *Clinical recommendations on the use of uterine artery embolisation in the management of fibroids, Second edition*, which is now withdrawn.

3. Literature review

The initial report of uterine artery embolisation (UAE) in the English literature appeared in 1995.¹ Since that time, it is estimated that in excess of 100,000 procedures have been carried out mainly in the USA and Western Europe. A large American registry reported in 2005³ and four separate randomised trials comparing UAE with surgery (mainly hysterectomy) were published between 2003–2008.^{4–7} Mid-term results to five years are available for two of these studies.^{8,9} A Cochrane review reported in 2006 and was repeated in 2012¹⁰ and a large UK retrospective comparative study (HOPEFUL) published in 2007.¹¹ More recently, a further small randomised, controlled trial has been published comparing UAE with uterus-sparing surgical treatment (myomectomy).¹²

NICE issued updated guidance in November 2010 stating that '(the) procedure is efficacious for symptom relief in the short and medium term for a substantial proportion of patients'.¹³ The most recent guidance from the American College of Obstetricians and Gynecologists (2008) recognises UAE as safe and effective.¹⁴

A US prospective registry (n=3,160)³ gives the most information on procedural safety due to the large numbers but it has no control group. It reported a 5.4% major complication rate at 30 days (the majority occurring post-hospital discharge) with three patients (0.1%) requiring a hysterectomy. There were no deaths. In a subgroup analysis, quality of life (QoL) – measured using a fibroid-specific QoL tool – was significantly improved over baseline at one year. The UK HOPEFUL study (n=1,108)¹¹ is also a large retrospective study comparing UAE with a matched hysterectomy cohort. It reported complication rates of 5% and a hysterectomy rate of 1%, with improved health status and symptom relief over baseline.

There are five randomised, controlled trials (RCTs) of UAE, comparing the procedure against 'surgery' (a combination of hysterectomy or myomectomy), hysterectomy or myomectomy.^{4–9,12} The RCTs are all relatively small, use varied outcome measures and only two of them have reported on long-term outcomes to five years.^{8,9}

Table 1. Randomised UAE trials, US registry and HOPEFUL study.

Study	Type	Year	n=	Arms	Primary outcome
Pinto ⁶	RCT	2003	57	Hysterectomy	Hospital stay
US registry ³	Voluntary registry	2005	3,160	n/a	n/a
EMMY ^{4,8}	RCT	2007	177	Hysterectomy	Freedom from hysterectomy
REST ^{5,9}	RCT	2007	157	Hysterectomy or myomectomy	QoL
HOPEFUL ¹¹	Retrospective cohort	2007	1,108	Hysterectomy	Multiple
Mara ⁷	RCT	2008	121	Myomectomy	Symptoms
FUME ¹²	RCT	2012	147	Myomectomy	QoL

Safety, efficacy and complications

Early and mid-term results to five years are encouraging and longer term data are awaited. The safety and efficacy of the technique has been established.^{3–9,11,12}

Around 80–90% of patients will be asymptomatic or have significantly improved symptoms at one year with an associated 40–70% reduction in fibroid volume. Hysterectomy may be necessary in up to 2.9% of cases. Early ovarian failure may occur in 1–2%, although this is largely confined to women over 45 or those approaching the menopause.¹⁵ Complications usually occur late (>30 days post-procedure), and may occur >1 year post-procedure.

UAE vs hysterectomy

Despite the heterogeneity of study methodologies and primary outcome measures, the results comparing UAE with hysterectomy are remarkably consistent. The outcomes after UAE in terms of symptom control are identical to those for hysterectomy at both one and five years of follow-up. Hospital stay and recovery of normal milestones are significantly shorter in UAE compared to surgery. Complication rates are broadly similar with both treatments, although the temporal distribution varies (most complications post-surgery occur before discharge, but for UAE they occur after discharge). Complications after one year are rare in both groups.

Re-intervention rates are significantly higher after UAE than after surgery with up to 32% re-intervention rates for either symptom recurrence or complication by five years (4% for surgery).^{8,9}

Cost-effectiveness analysis at one year shows UAE to be significantly cheaper (by approximately £1,000 per case); however, this benefit is lost by five years due to the greater rates of secondary intervention.^{9,16}

In summary, UAE is a very useful uterine-sparing procedure that (rather like endometrial ablation for dysfunctional uterine bleeding) spares the majority of women a hysterectomy. The faster, shorter recovery period of UAE with uterine preservation needs to be weighed against the need for further treatment in about a third of patients.

UAE vs myomectomy

Myomectomy generates strongly held opinions within the gynaecological community and UK centres vary widely in their activity levels. There have been no randomised trials comparing myomectomy with other conventional treatments. There are two RCTs comparing myomectomy with UAE.^{7,12} In total, 268 patients were randomised: 132 to UAE and 136 to myomectomy. In one of the trials the majority (42 of 63) of myomectomies were laparoscopic. The findings of the two studies were very similar: symptom control and complication rates were the same in both UAE and myomectomy groups. Recovery time and hospital stay were significantly shorter after UAE but there was a significantly higher re-intervention rate. A prospective non-randomised study comparing myomectomy (n=60) with UAE (n=149) found similar results with equivalent improvements in QoL scores but with a more rapid recovery and fewer side-effects following UAE.¹⁷

Further Level 1* evidence of the relative outcomes of UAE and myomectomy on symptoms and quality of life is required. In the UK, a large-scale RCT of UAE versus myomectomy (FEMME), is currently (as of April 2013) recruiting and participation is encouraged.¹⁸

Fertility, UAE and myomectomy

In women who wish to retain their fertility, a hysterectomy is clearly contraindicated.

The evidence for the beneficial effect of myomectomy or UAE on fertility and pregnancy outcomes is weak (myomectomy) or lacking entirely (UAE). Similarly there is very little literature on the differential effects of myomectomy and UAE on subsequent fertility in women with fibroids. Fertility was a secondary endpoint in one of the trials of UAE vs myomectomy mentioned above:⁸ there were more pregnancies, and significantly fewer miscarriages in the myomectomy arm at two years although the number of events overall was small (26 women in the UAE group desired subsequent pregnancy, of whom 13 became pregnant and nine miscarried, all in the first trimester). Equivalent figures for the myomectomy group were 41 (desire), 31 (achieved) and six (miscarried). It is impossible to draw firm conclusions from such sparse data.

*Level 1 evidence is defined as evidence from a systematic review of a number of randomised, controlled trials (1a) or evidence from a single randomised, controlled trial (1b). See <http://www.cebm.net/?o=1025>

A recent systematic review of pregnancy outcomes after UAE found a miscarriage rate of 35% of 227 pregnancies. A control group of 1,121 pregnancies in women with fibroids was associated with a miscarriage rate of 17%. Miscarriage rates after the first trimester were the same in UAE and control groups. Rates of malpresentation, small for gestational-age fetuses and pre-term delivery were the same in both groups. There were increased rates of caesarean section and post-partum haemorrhage in the UAE group.¹⁹ However, fibroids in the control group were much smaller, many fewer in number and were not causing symptoms. Moreover, the women in the control group were younger. These significant confounders ultimately make the comparison meaningless.

Currently it is impossible to make an evidence-based recommendation about treatment (UAE or myomectomy) for women with fibroids who wish to maintain their fertility. Clearly, more evidence is needed to establish the role of these treatments in this patient group. A large RCT with long-term assessment is required. The FEMME trial (see above¹⁸) includes assessment of reproductive potential before intervention and subsequent pregnancy rates as a secondary endpoint in its design. In the meantime and in the current absence of more robust evidence, treatments for fibroids (UAE or myomectomy) in women of childbearing age who wish, or might wish, to become pregnant in the future should be offered only after fully informed discussion.

UAE and adenomyosis

There have been 15 cohort studies assessing the efficacy of UAE in adenomyosis. In 511 women, symptomatic relief was reported by 387 (75.7%).^{20,21}

Although there is no Level 1 data, sustained clinical and symptomatic improvements were reported with minimal side-effects. Cost-effectiveness and retention of fertility mean UAE can be considered as a treatment option for patients with adenomyosis.

Summary

The conclusion of a recent Cochrane review (2012)¹⁰ offers an excellent and brief synopsis of the current evidence base for uterine artery embolisation. It stated that ‘... UAE appears to have an overall patient satisfaction rate similar to hysterectomy and myomectomy, while offering an advantage with regards to a shorter hospital stay and a quicker return to routine activities. However, UAE is associated with a higher rate of minor complications and an increased likelihood of requiring surgical intervention within two to five years of the initial procedure. There is very low level evidence suggesting that myomectomy may be associated with better fertility outcomes than UAE, but more research is needed’.

Table 2. Synopsis of the UAE randomised trials and HOPEFUL study

Outcome	Surgery	UAE	Statistical significance
Hospital stay	Longer	Shorter	*
Recovery of milestones	Later	Sooner	*
Symptom control	Good	Good	*(improvement over baseline)
Quality of life	Better	Better	
Re-intervention	Uncommon	More common	*
Cost-effectiveness (five years)	Cheaper	More expensive	

* indicates statistical significance $p < 0.05$

4. Indications for fibroid embolisation

The main indication for UAE is symptomatic fibroids (causing heavy menstrual bleeding, dysmenorrhoea, pain, dyspareunia, or other pressure effects on urinary or gastrointestinal tract) in women who desire treatment. The technique has been recommended by NICE for this indication.¹³ Although UAE in the presence of adenomyosis is less efficacious,^{20,21} it may still be considered in adenomyosis or when adenomyosis and fibroids co-exist after appropriate counselling.

Women who have a medical condition contraindicating surgery, who are unwilling to receive a blood transfusion (such as Jehovah's Witnesses) or who have

had previous unsuccessful surgery for fibroids may find UAE a particularly attractive method of treatment. However, they must be counselled that complications of the procedure may lead to the requirement for surgery in a small proportion of cases.

Occasionally women may be referred for UAE for fibroids causing infertility (but without other symptoms). The use of UAE in this situation should be considered with caution after assessment and treatment under the care of a gynaecologist with an interest in assisted reproduction and fertility (see Section 6).

5. Contraindications

The following are absolute contraindications to performing the procedure:

- Any evidence of current or recent infection in the genital tract
- Serious doubt as to the diagnosis due to clinical factors or inadequate imaging
- Asymptomatic fibroids
- Pregnancy
- Where a patient would refuse a hysterectomy under any circumstances for social or cultural reasons – even after appropriate counselling that this is necessary after UAE in only a small proportion of cases.

With respect to relative contraindications, it is believed that narrow-stalked, pedunculated submucosal fibroids might detach into the endometrial cavity post-embolisation. Similar concerns have been raised for large intracavity submucosal fibroids where there is a risk of significant fibroid sloughing into the endometrial cavity. In both cases there is the potential for fibroid material to cause cervical obstruction and occasionally sepsis. Embolisation of these lesions should only be

undertaken after careful consideration and with plans in place for hysteroscopic fibroid retrieval from the endometrial cavity were this to occur. Pedunculated subserosal fibroids are also at risk of detachment post-embolisation and arrangements may need to be made for laparoscopic retrieval.

It has been suggested that the outcome from embolising small fibroids is better than for large fibroids,¹⁵ although most evidence suggests that complication rates are similar. Therefore, large fibroids should not be considered a contraindication. If a large fibroid is associated principally with bulk symptoms, considerable caution must be exercised since volume reduction might not be sufficient to satisfy patient expectations.

A desire to preserve fertility in women of childbearing age with symptomatic fibroids is a relative contraindication. Decision-making in this situation is complex and is considered more fully below (Section 6).

6. Subfertile patients and those contemplating a subsequent pregnancy

There is a considerable body of literature implicating uterine fibroids as a cause of subfertility. Intracavity and intramural fibroids may act by a mechanical effect leading to cavity distortion, although data derived largely from *in vitro* fertilisation (IVF) studies suggest that fibroids exert a negative effect on fertility even if the cavity appears hysteroscopically normal. This may be due to effects on uterine blood flow, impaired embryo implantation or abnormal sperm migration.²² Despite this, many women with relatively large fibroids conceive without difficulty.

Fibroids may also contribute to problems during pregnancy itself. There are reports associating them with an increased risk of first and second trimester miscarriage, pain due to fibroid degeneration, premature labour, mechanical complications in labour and postpartum haemorrhage.

Effective management of the patient with fibroids who wishes to conceive cannot as yet be determined by an evidence-based approach using RCT data. For example, the effect of myomectomy for intramural fibroids on fertility rates is contentious – which, it could be argued, makes the significance of intra-mural fibroids in subfertility uncertain.

It is clear that subfertility resulting from fibroids is not absolute and many patients will conceive without intervention. It is therefore sensible to ensure that other causes of subfertility have been sought and, if found, treated appropriately. If subfertility seems likely to be the result of uterine fibroids, a management plan should be devised after careful discussion with the couple concerned.

UAE may be appealing for women with large or multiple fibroids with subfertility. Treatment should reduce fibroid volume and might potentially improve the chance of a successful pregnancy. On the other hand, UAE might result in adverse effects on placental blood supply and increase the risk of uterine rupture in pregnancy due to relative myometrial ischaemia.

Myomectomy might be appealing for women with a single dominant fibroid in a surgically accessible location, as the treatment will remove the fibroid. However, myomectomy might result in uterine scarring, adhesion formation, uterine perforation or focal uterine weakness.

As discussed above (Section 3), the relative effects of UAE and myomectomy on fertility and pregnancy outcomes is unknown though successful pregnancy is certainly possible after UAE.¹¹

Women who desire pregnancy but experience subfertility or recurrent miscarriage due to fibroids, can be offered UAE after careful counselling and review by a gynaecologist with an interest in assisted reproduction and fertility.

7. Counselling, consent and communication

Recent NICE guidance¹³ states that women with symptomatic fibroids can be offered UAE as one of their treatment options. Gynaecologists or primary care physicians with adequate gynaecology experience, accreditation and competence should counsel the patient about the available options and if the patient wishes to consider UAE, she should be referred to an experienced vascular interventional radiologist. Local governance arrangements should ensure gynaecology input into patients referred direct to an interventional radiologist from primary care.

The radiologist should see the patient in an outpatient setting. All notes, letters and previous imaging should be available. The patient should be counselled carefully. In particular, the discussion should include the following:

- A clear description of the outcomes after UAE in comparison with the alternatives (for example, hysterectomy or myomectomy). The interventional radiologist should be familiar with the literature on safety, outcomes and complication rates
- A full description of the procedure, an indication of how long the patient might spend in hospital and how long the recovery time is likely to be
- A full discussion of complications and their incidence (see Section 10). This should include:
 - Minor complications such as puncture site bruising and self-limiting vaginal discharge (which can occur in 20–30% of patients^{4,5,11})
 - Post-embolisation syndrome
 - Passage of fibroid material (which may require additional procedures to remove in 6% of patients)

- Permanent amenorrhea (which overall occurs in 1.5–7% of patients^{11,15}) but is markedly dependent on the patient's age
- Non-target embolisation and ovarian dysfunction (which is rare)
- Urgent hysterectomy due to infection (in 1%^{11,15} which may occur several months after UAE)
- Patients should be informed that they may require further treatment for recurrent symptoms. The younger they are, the more likely this is. The risk is 25% (by five years) for patients less than 40 years of age and 10% for those between 40 and 50.^{5,11} Further treatment might include repeat UAE, exploration of uterine cavity, myomectomy or hysterectomy
- Those patients who desire pregnancy or wish to maintain fertility should be told that the effects of UAE on fertility and on pregnancy are uncertain though successful pregnancy is possible in women undergoing UAE.

Time should be allowed for consideration by the patient. Providing all the above is discussed with the patient, a standard hospital consent form is sufficient. Patient information leaflets should be available. General practitioners must be kept aware of the details of the patient's decision, the procedure date and outcome and follow-up arrangements. General practitioners should also be made aware of the possible complications, such as post-embolisation syndrome or the passage of pieces of fibroid, and the recommended management plan were these to arise (see Appendix 1).

8. Pretreatment assessment and prophylactic measures

Accurate pretreatment diagnosis is essential and should involve a gynaecologist and interventional radiologist. Clinical assessment and investigation should ensure that bleeding irregularities are not due to pathology other than the fibroids. Magnetic resonance imaging (MRI) is superior to ultrasound in diagnosing fibroids and the technique is more likely to diagnose adenomyosis if present.²³ There is also evidence that MRI alters management in as many as 22%, with 19% not undergoing UAE.²⁴

UAE does not allow tissue diagnosis and the radiologist undertaking the procedure should be alert to imaging appearances that are not typical of benign fibroids. It is recognised that differentiating between uterine sarcoma and benign myoma remains problematic. The utility of MRI in diagnosing sarcomatous change in fibroids is suboptimal in the absence of 'hard' signs such as invasion through the fibroid capsule or lymphadenopathy. There has been at least one case of an apparent fibroid failing to respond to UAE, which proved subsequently to be a sarcoma.²⁵ It is essential that the referring gynaecologist (or local gynaecologist for patients referred from primary care) ensure that an up-to-date assessment of the patient is undertaken before the procedure is performed.

Every effort should be made to avoid fibroid embolisation procedures in the presence of an early pregnancy. Embolisation can be carried out at any stage of the menstrual cycle provided pregnancy is ruled out. A pregnancy test should be performed pre-procedure and the procedure only undertaken if this is negative.

Particular consideration has been given to the risk of infection complicating the procedure. Pre-treatment swabbing of the genital tract is done in some centres but its value is uncertain, although vaginal discharge or other symptoms and signs suggestive of active gynaecological infection should prompt investigation and delay UAE until genital tract infection is excluded. An intrauterine contraceptive device (IUCD), if used, should ideally be removed prior to the procedure though a small study did not find that the presence of an IUCD increased the risk of infection.²⁶ The avascularity induced by arterial embolisation leads to

tissue necrosis, which might predispose patients to a risk of anaerobic bacterial infection. Likely causal organisms include *Bacteroides* and *Streptococcus* species and *Escherichia coli*. Published work suggests that UAE is associated with a post-treatment infection rate of 2% despite prophylactic antibiotic therapy. Evidence for the use of prophylactic antibiotic therapy in vaginal hysterectomy,²⁷ caesarean section²⁸ and colorectal surgery²⁹ would suggest that single-dose prophylactic antibiotic therapy in UAE is reasonable though the time of greatest risk for infection may well be several months after the primary procedure. A drug combination such as metronidazole with a cephalosporin, a quinolone such as ciprofloxacin, gentamicin or amoxicillin may be used. Data that perioperative antibiotics are useful is limited¹¹ and ultimately the use of antibiotics is at the discretion of local hospital policy.

Normal guidance on the use of prophylactic heparin should apply if a patient appears to be at increased risk of thromboembolic disease.³⁰

The use of gonadotropin-releasing hormone (GnRH) analogues to reduce fibroid vascularity and size and has been described as tending to make the uterine arteries smaller, more prone to spasm and technically more challenging to catheterise. In the EMMY trial, a small number of patients underwent UAE within 60 days of GnRH treatment, with a 60% (three of five) unilateral or bilateral technical failure rate.³¹ Overall however, prior GnRH administration was not associated with either technical failure or vasospasm. Deferring UAE beyond 60 days after GnRH analogue administration has not been shown to improve outcome.³² A more recent publication³³ suggests that GnRH administration enhances the technical outcome (MRI-assessed volume reduction) of UAE for large fibroids. Whether GnRH analogue administration should be deferred prior to UAE is therefore also at local discretion, although deferment beyond 60 days is unlikely to be beneficial.

Guidance on the resumption of sexual activity and the use of tampons post-procedure is not evidence-based and again will depend on local practice.

9. The procedure

The objective of UAE is to completely infarct all the fibroid tissue while preserving the uterus, ovaries and surrounding pelvic tissues. The technical aspects of UAE to achieve this aim continue to evolve.

The procedure will usually be performed by a consultant interventional radiologist with competence in a variety of endovascular procedures and particularly embolisation techniques. It should not be undertaken by a trainee without appropriate supervision. An up-to-date dedicated fixed C-arm fluoroscopic unit is required which must support 'road mapping' and dose reduction modes (such as pulsed fluoroscopy). An appropriately trained radiographer is essential to minimise radiation doses – and these doses should be audited.

Patients are normally admitted to hospital on the day of the procedure. Although admission to a gynaecological unit is ideal, other models (such as admission to a vascular surgical unit) are acceptable. There should be clear identification of the responsible clinician. The patient should give consent on the ward (or in clinic) by the operator before the procedure.

Pain is an expected early side-effect of successful UAE and should be managed proactively. Protocols for the management of pain should be in place and adhered to. Analgesia should be instituted prior to the procedure commencing. Antispasmodics such as hyoscine butylbromide (Buscopan) reduce opiate requirements and are recommended.

Routine placement of a bladder catheter is unnecessary and a potential source of infection. Venous access should be established before the procedure, allowing parenteral conscious sedation and analgesia during and following the procedure. Monitoring of pulse, oxygen saturation, non-invasive blood pressure, sedation score and respiratory rate is mandatory. Oxygen should be administered wherever sedation is used. A dedicated member of staff (usually a nurse) should be available to monitor the patient and administer appropriate medication.

Resuscitation facilities should be available and the radiologist and other support staff must be competent in its use.

Most operators use right-sided percutaneous femoral arterial access, although some employ a bilateral femoral artery approach. The catheter (4 or 5 French, or microcatheter) is manipulated under fluoroscopic guidance into the uterine artery via the anterior division of the internal iliac artery. Once a stable position is obtained, the embolic agent is injected under fluoroscopic control to avoid reflux and non-target embolisation. The opposite uterine artery is then embolised in a similar fashion.

There are a variety of embolic agents available and little evidence to support the use of one over another. They are available in a variety of sizes: most operators use embolic agents with a diameter in the range of 300–750 micrometres, with larger sizes preferred. The 'embolisation endpoint' remains a subject of debate and may be agent-specific, although most operators embolise to complete stasis in the uterine artery.

Some operators advocate imaging the ovarian arteries at the time of the procedure, although embolisation of these vessels should not normally be undertaken at the time of a first embolisation and never without a careful discussion with the patient (in advance), warning of the risk of ovarian damage. The reflux of contrast up the ovarian artery during embolisation in the uterine artery (due to uterine–ovarian artery anastomoses) does not preclude further embolisation to endpoint, although most operators would choose to 'upsized' the embolic agent utilised to one of a larger diameter.

Once the procedure is complete the catheter is removed and haemostasis obtained, either manually or with the use of a vascular closure device. The latter has the advantage of allowing the patient to adopt a comfortable position in bed at an early stage. The total procedure time is usually in the range of 30–90 minutes.

10. Complications

Immediate (peri-procedural) complications

Local complications such as groin haematoma, arterial thrombosis, dissection and pseudoaneurysm can occur; however, the cohort of women undergoing UAE has a low incidence of vascular disease and the arterial puncture is rarely larger than 5Fr. Consequently these complications are uncommon.

Significant reactions to iodinated contrast media are very rare.

Spasm in the uterine artery can be caused by inelegant catheter/wire manipulation. It can be minimised by using careful technique and may be reversed by administering vasodilators through the catheter. Microcatheters are very useful for tortuous arteries or where spasm persists. If persistent, spasm can result in incomplete embolisation.

Non-target embolisation (particles reaching other vascular beds) is rare and should not occur with good technique – although the presence of ovarian–uterine anastomoses may not always be obvious initially and can theoretically result in inadvertent ovarian embolisation and infarction. Permanent amenorrhoea following UAE might be considered a result of ovarian non-target embolisation. This is discussed more fully below (late complications).

Early complications (within 30 days)

Post-embolisation syndrome – this consists of pain, nausea, fever and malaise. There are often raised inflammatory markers and white cell count. It is frequent and is usually self-limiting with symptoms commonly subsiding within ten days to two weeks. All patients should be administered analgesics and anti-inflammatory medications following UAE to manage the syndrome. Prolonged (over ten days) and deteriorating symptoms should raise the suspicion of infection with which it shares many features. Readmission may be required in a minority (3–5%) for parenteral analgesia and fluid resuscitation.

Other complications such as urinary tract infection and deep venous thrombosis are very rare.

Late complications (beyond 30 days)

Unlike surgical treatments for fibroids, most complications of UAE occur more than 30 days after the procedure. They can occasionally occur over a year (up to four years) after the procedure. Patients, medical and nursing staff need to be aware of this. Post-UAE patient information leaflets with contact details (including telephone numbers) are suggested.

Late complications include the following.

Vaginal discharge – this is relatively common (16% at 12 months),³ but is almost always self-limiting. If the discharge is foul smelling and purulent, infection is likely and should be treated, initially empirically. Persistent discharge with pain raises the suspicion of fibroid expulsion (see below).

Fibroid expulsion and impaction – expulsion of fibroid material occurs in up to 10% of women and is more frequent with submucosal fibroids. Management is usually expectant although operative (usually hysteroscopic) intervention may be required to remove the sloughed material, especially if it impacts in a non-dilated cervix and occludes the internal os.

Infection – endometritis occurs in 0.5% of cases and is sometimes associated with fibroid expulsion. It usually responds well to antibiotics. Causative organisms are normally anaerobes. Admission for parenteral antibiotics and IV fluids is advised and there is generally a good response. Dual antibiotic therapy is recommended and early imaging (with MRI) to exclude abscess, pelvic collection, retained tissue fragments and fibroid impaction is advised. Patients should be assessed by both a gynaecologist and radiologist as (rarely) infection can progress and lead to septicaemia and multi-organ failure. Emergency hysterectomy may occasionally be indicated for overwhelming sepsis. This can be a technically difficult procedure and will need an experienced gynaecological surgeon. There has been one fatal case of infection reported in the world literature. Hysterectomy has been performed for infection starting over one year after UAE though without major sepsis.

Amenorrhoea – In the UK and US registries, the overall incidence of amenorrhoea at 12 months was 1.5 and 7% respectively.^{11,15} The incidence of amenorrhoea is

markedly age-related being much less common (<1%) in women under 40 years of age.^{11,15} Eighty-five per cent of women experiencing amenorrhoea after UAE are over 45 years of age.¹⁵ It is unknown whether amenorrhoea after UAE is due to local effects on the uterus, effects on the ovary or both. Uterine artery to ovarian artery anastomoses are angiographically visible on at least one side in 46% of women³⁴ and it has been suggested that the increased incidence of amenorrhoea in older women is due to greater susceptibility of their ovarian tissue to ischaemia induced by inadvertent embolisation.³⁵ Godwin *et al*¹⁷ found transient ovarian dysfunction (defined as hot flushes or amenorrhoea with elevations in follicle-stimulating hormone [FSH] and luteinising hormone [LH]) in two of 149 patients undergoing UAE, although no patient had permanent ovarian failure.

Hysterectomy can also affect ovarian reserve. A recent subgroup analysis from the EMMY trial indicated UAE and hysterectomy affect ovarian reserve equally, as assessed by FSH and LH assay.³⁶

Sexual function – sexual function after UAE has been reported as being improved in 26% of women, worse in 10% and unchanged in the remainder.³⁷ In the US registry, the reported incidence of unwanted changes in sexual function at 12 months was 12%.¹⁵ Sexual function could be impaired because of vaginal discharge or interruption of blood supply to the clitoris, cervix and uterus by the embolic procedure. There is no difference in measures of sexual function or body image at two years between patients undergoing UAE or hysterectomy.³⁸

11. The individual's responsibility in clinical practice

The initial decision to treat fibroids should follow discussion between the patient and gynaecologist or GP with adequate gynaecology experience, accreditation and competence. Once the woman has been referred for consideration of embolisation, the decision to treat, work up, pre-procedural imaging and the technical details of the procedure are the responsibility of the radiologist. For patients referred direct from primary care, the radiologist should ensure that gynaecology input is obtained. Post-procedural care may be gynaecology-led, radiology-led or a combination of both. The most important element in the continuing care of the patient is that they should have rapid access to follow up to allay any anxieties relating to expected sequelae and to act immediately if there is any question of the development of a problem. Models may be gynaecology-led or radiology-led although it is anticipated, given the current service structure in the NHS, that most patients with complications will be admitted under the care of a gynaecologist. In any event, close communication is vital.

The Academy of Medical Royal Colleges has issued a statement³⁹ stating that 'Patients admitted to a hospital bed should be under the care of a named consultant at all times during their hospital stay. This principle operates even when more than one consultant, often from different disciplines, provides shared care for the patient; in these circumstances the lead consultant should be clearly identified in the case notes. When the

patient requires an invasive procedure such as an interventional radiological technique, an endoscopic procedure or any form of surgery it may be appropriate, depending on the circumstances and the complexity of the procedure, to transfer, temporarily but formally, the responsibility for the patient to the individual specialist performing the procedure. The period of transfer and the arrangements for emergency cover must be formally agreed either by specific instructions in the patient's hospital notes or by a general protocol. In the case of an inter-hospital transfer, the referring hospital consultant is responsible for the care of the patient until a formal handover takes place'.

It is reasonable to expect that the care of patients undergoing UAE meets the standard expressed in this statement.

Clinical radiologists may take principal medical responsibility for the care of a patient for part or all of the hospital stay on the same basis as any other registered medical practitioners, provided that their skills, training and available facilities are sufficient to ensure appropriate care until responsibility is reassumed by the referring medical practitioner.

Where radiologists are working in a hospital without a gynaecological unit, agreed procedures for communication between clinicians allowing rapid recourse to an appropriate specialist are essential.

12. Follow-up

A protocol must be available clearly describing roles and responsibilities of radiologist and gynaecologist (and occasionally other clinicians) for patient follow-up. Patients should have rapid access to a follow-up service and their GP should be made aware of this. Excellent communication with the patient's GP is essential as they may not be conversant with UAE technique, side-effects, complications or route of referral should a problem develop. Clinical follow-up is advised in outpatients: at least one follow-up

appointment at six months' post-procedure should be offered, although details of follow-up protocols vary. Telephone follow-up is acceptable as long as clinic follow-up is available if requested or necessary. Imaging is mandatory if symptoms persist or recur.

Any complication should result in thorough clinical assessment. There should be a low threshold for referral for a gynaecological opinion (Appendix 1).

13. Suggested areas for further study

Studies to date have proven the safety and efficacy of UAE in the short- and medium-term as an effective treatment for symptomatic uterine fibroids. Further research is required into certain technical aspects of the procedure and fertility.

Areas for further research include:

- Large-scale studies comparing UAE with myomectomy for symptom relief, fertility and pregnancy outcomes and ovarian reserve. There is currently a multicentre RCT recruiting in the UK (FEMME) to address this and participation is encouraged¹⁸
- Optimisation of embolisation technique, including identification of the ideal embolic agent and embolic endpoint
- Efficacy of prophylactic antibiotics
- Comparisons with other non-surgical techniques such as MR-focused ultrasound therapy
- Stratification of results by fibroid position, size and number
- Identification of a need to screen for pretreatment infection
- Effects on psychosexual function.

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Appendix 1. Post-procedure care and management of complications

Post-embolisation syndrome is not uncommon in the first two weeks after UAE. It is associated with malaise, a mild temperature, nausea and lower abdominal pain. There are often raised inflammatory markers and white cell count.

It may be difficult to distinguish the syndrome, from infection. Pyrexia, malaise, lower abdominal pain and a PV discharge may be associated with pyometra.

All patients presenting with concerns after UAE need to be investigated thoroughly (usually by admission to a gynaecology unit) to ensure that there is no serious complication. Complications usually present late (>30 days' post-procedure) and may be very delayed (up to four years' post-procedure)

Patients should be treated empirically.

Suggested minimum investigations

- Temperature, pulse, respiration rate and blood pressure
- Vaginal examination and high vaginal swabs
- Urine dipstick analysis, culture and antibiotic sensitivity
- Bloods: full blood count, urea and electrolytes and assays for C-reactive protein
- If pyrexial, blood cultures
- Transabdominal and/or transvaginal ultrasound or pelvic MRI (MRI is preferred: transfer to a central unit if MRI is not available on site).

Symptoms/signs	Treatment
Pyrexia, fever/rigors General feelings of malaise Abdominal pain Uterine tenderness	<p>*Within the first two weeks following the procedure, these symptoms may be post-embolisation syndrome in which case analgesia, antipyretics and reassurance is all that is necessary.</p> <p>If symptoms are deteriorating, are severe, are occurring beyond two weeks of the procedure or if there are other clinical causes of concern then infection must be considered. Admission for intravenous antibiotics and pelvic imaging is recommended.</p> <p>Rarely, hysterectomy may be necessary.</p>
Vaginal discharge (A brownish/ pink discharge is not uncommon for several weeks post-UAE. If the discharge is causing vulval irritation or it is offensive, then consider infection.)	<p>If patient feels well no treatment is needed.</p> <p>If suspicion of vaginal infection treat appropriately with antibiotics or antifungals. Repeat swabs to ensure clear of infection.</p> <p>If the PV discharge becomes distressingly heavy or persistent, hysteroscopic evacuation of the uterus may be necessary.</p>
Passage of fibroid tissue PV. (This may occur, in about 10% of patients after treatment. Passing of a complete fibroid is rare. It is associated with fresh PV bleeding and acute sustained abdominal pain, which does not resolve with simple analgesics. More common is the passage of small fragments of tissue)	<p>NSAIDs may need to be taken for several weeks. Clear os of any debris. Admission for pain control may be necessary. Once fibroid passed, patients usually recuperate quickly.</p>

If patient is reviewed and then sent home, she must be advised to return immediately if there is any deterioration in her symptoms.

Appendix 2. The working parties

2013 working party

Dr Christopher Hammond BM BCh MA (Oxon) MRCS FRCR (Chairman)

Dr Tony Nicholson BSc MSc FRCR FFRRCSI EBIR

Professor Anthony Watkinson BSc MSc (Oxon) FRCS FRCR EBIR

Dr Philip Owen MB BCh MD FRCOG

Professor Mary Anne Lumsden FRCOG

Mrs Geeta Kumar FRCOG

Dr Paul Crowe MA MB BCh BAO FFRRCSI FRCR

Dr Nigel Hacking BSc MB BS FRCP FRCR

2009 working party

Professor Anthony Watkinson BSc MSc (Oxon) FRCS FRCR (Chairman)

Professor Jon Moss FRCS FRCR

Dr Tony Nicholson BSc MSc FRCR

Professor Mary Ann Lumsden MD FRCOG

Mr Michael Maresh MD FRCOG

Mr Sanjay Vyas MD FRCOG

2000 working party

Mr KR Peel FRCS (Edin) FRCOG (Chairman)

Professor WL Ledger MA DPhil MRCOG

Dr JF Reidy FRCP FRCR

Dr AA Nicholson BSc MSc FRCR

Professor CJG Sutton FRCOG

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