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Uterine Artery Embolization in Paediatric Patients - A Novel Treatment Option in Special Situations.

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Abstract:
Uterine artery embolization is a novel innovative minimally invasive procedure that has been gaining popularity in India for treatment of fibroids since the last decade performed by interventional radiologists. It's a treatment option for women who are infertile and suffer from symptomatic fibroid as it gives a chance to preserve fertility and avoid complicated surgeries to the uterus. Currently it's the procedure of choice in women with multiple symptomatic fibroids who wish to preserve the uterus. The advantages of the procedure are that it is minimally invasive with very little blood loss. It is performed under local anaesthesia and sedation through the groin puncture of the femoral arteries and the post procedure hospital stay and recovery is faster. Paediatric uterine artery embolization is a challenging area with very few researches and cases reported worldwide. In our experience we have found it to be a safer and effective alternative to female children who have severe menstrual blood loos due to secondary causes in whom hysterectomy is unethical. Here we discuss a case series of children who presented in a state of haemorrhagic shock and successfully underwent uterine artery embolization in our institute for uncontrolled menstrual bleeding secondary to platelet dysfunction.

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I. Introduction.

Uterine artery embolization (UAE) or Uterine fibroid embolization (UFE) was first performed in 1974 in Paris by Jean Jacques Merland by a neuroradiologist. He later collaborated with Dr Jacques Ravina a gynaecologist to perform UAE prior to myomectomy to reduce blood loss. Uterine fibroids are estrogen responsive, benign tumours of the uterus that arise from the smooth muscles of the myometrium. They are histologically composed of spindle shaped smooth muscle cells in a fibrous stroma with a characteristic whorled pattern. They are the most common benign tumours of the uterus and are seen in approximately 40% of the females in reproductive age group. They tend to grow in size during pregnancy and tend to atrophy after menopause due to hormonal changes in the body. Based on thelocation of these tumours they are classified as intramural if they are within the myometrimum, submucous if they are located just beneath the endometrial lining and subserous when they are exophytic and covered by peritoneum.

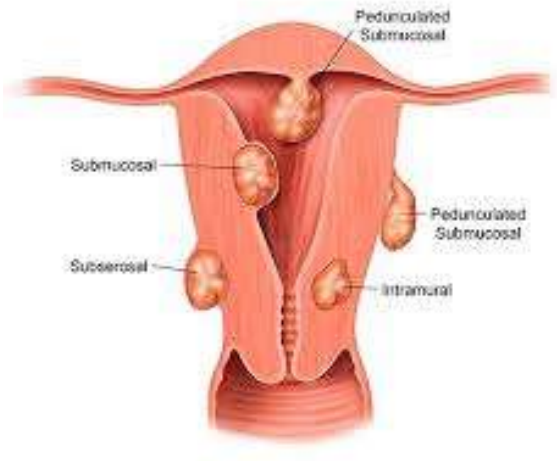

Fig 1: Graphical representation of the various types of uterine leiomyomas.

Largely fibroids are asymptomatic and detected only incidentally during a pelvic ultrasound. However 25-30% of women have symptomatic fibroids and majorly of them seek treatment of menstrual irregularities which include excess volume and duration of cycles. Quiet a number of women experience lower abdominal pain, bladder and bowel symptoms and a feeling of fullness in the lower abdomen. About 10% of women fibroid can be the cause of primary infertility especially when they are situated in the cornua or distort the endometrial cavity which can lead to problems in embryo implantation and recurrent abortions.

Myomectomy has been the preferred treatment option from time in memorial for females with symptomatic fibroids in the reproductive age group. Hysterectomy is considered in women with large fibroids in the perimenopausal and menopausal age group. These surgeries are associated with risks of severe intraoperative blood loss and chances of injuries to the bowel and bladder. The post-operative morbidity and recovery period is also high following major pelvic surgeries. Long term complications following pelvic surgeries include dense post-operative adhesions which can lead to chronic pelvic pain and recurrent intestinal obstruction. Laparoscopic myomectomy is a minimally invasive surgery to remove fibroids with advantages of scar less blood less technique, however large fibroids which are difficult to access can be tricky to remove using laparoscope.

Patient Selection.

Ideal candidates for UAE include women with symptomatic fibroids in the reproductive age group and those with primary infertility due to fibroids. UAE is an adjuant to myomectomy to reduce perioperative blood loss and improve haemoglobin. UAE is useful treatment in women with recurrent fibroids and extensive pelvic adhesions. Major advantage of Uterine artery embolization is that it treats all fibroids simultaneously as fibroids as exclusively supplied by uterine arteries. It can cure bilateral cornual uterine fibroids. Pedunculated submucous and subserous fibroids are a relative contraindication for embolization as they can get separated from the uterine and lead to wandering intraabdominal parasitic fibroids. Large submucous fibroids can similarly get expelled and lead to painful impaction within the cervical canal which warrants hysterectomy. Other indications for uterine artery embolization includes dysfunctional uterine bleeding, Adenomyosis, Secondary menorrhagia due to platelet dysfunction. Relative contraindications for UAE includes renal failure, allergy to iodinated contrast agents, uncorrected bleeding diastasis and concurrent uterine and adnexal infections. Absolute contraindications include pregnancy and gynaecological malignancies.

Preoperative evaluation.

Preoperative evaluation includes proper history including menstrual history and through physical examination of the women. Proper pelvic evaluation of the women should be carried out and the findings documented. Laboratory investigations including complete blood counts including platelets along with bleeding and clotting time. PT, INR and apTT must be carried out in all patients to assess clotting status. Renal and Liver function tests maybe be carried out.

Imaging studies are a must before procedure to assess the size location and number of fibroids. The most commonly performed investigation is Ultrasound of the pelvis which can be performed transabdominally or transvaginally. Transvaginal scan uses a high frequency probe of 7-12MHz and has higher resolution and low penetration and can be performed in obese women without full bladder. The advantages of ultrasound is that its real time, lack ionizing radiation, rapid and can be done in bed side and repeated when required. Although ultrasound is technically difficult to perform and requires a trained operator with a learning curve to practice. Contrast enhanced ultrasound provides an added advantage of assessing the vascularity of the fibroids.

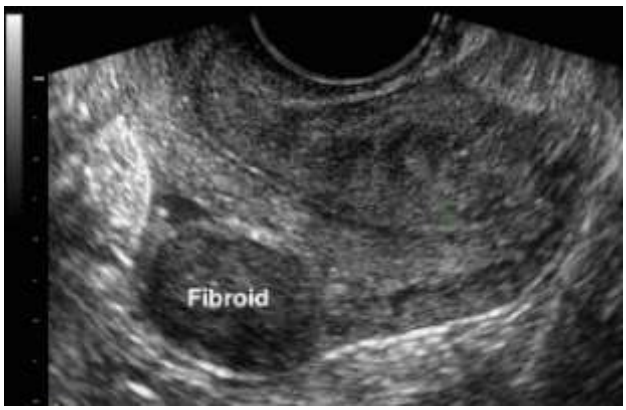

Fig 2: Transvaginal ultrasound in a 28 year old woman depicting a well circumscribed hypoechoic subserous fibroid in the posterior wall of uterus.

MRI of the pelvis with gadolinium contrast is the most commonly performed imaging modality which gives maximum information to the interventional radiologist and helps in preoperative planning and patient selection. Fibroids appear isointense to myometrium on T1WI and slightly hyperintense on T2WI. They enhance on post contrast T1 weighted fat supressed images. Calcified fibroids appear hypointense on all sequences due to the paramagnetic effect. Fibroids with cystic degeneration shows heterogeneous enhancement on post contrast images. Fibroids showing lack of enhancement in MRI respond poorly to UAE than those that enhance. Fibroids reaching upto the level of umbilicus of 20 weeks size derive maximum benefits of embolization. Large fibroids post UAE are associated with morbidity of post procedure intractable pain and post embolization syndrome.

Fig 3: Sagittal T2 weighted MRI image showing bulky anteverted uterus multiple well circumscribed hypointense fibroids of varying sizes within the myometrium.

Anatomy of uterine arteries.

Uterine arteries arise from the medial surface of the anterior division of the internal iliac arteries. Very rarely they can arise from the lateral or anterior aspect. The course medially at the ischial spine within the lower aspect of broad ligament till the level of internal os and ascends upwards within the parametrium and anastomose with the tubal branches of ovarian vessels near the cornua. The sent spiral tortuous branches which supply the body of uterus and anastomose with the contralateral fellow along the anterior and posterior aspect of uterus forming an anastomotic arcade. The ureter courses below the uterine artery within the parametrium.

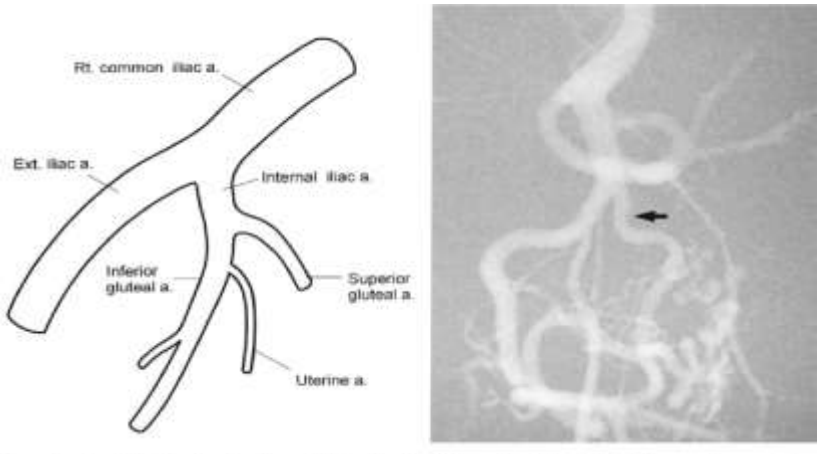

Fig 4: Schematic diagram depicting the anatomy of the uterine as it arises from the anterior division of internal iliac artery with corresponding angiogram images with uterine artery shown by black arrow.

Uterine Artery Embolization Technique.

The procedure is performed taking all aseptic precautions in a Cath Lab using fluoroscope. The femoral artery either right or left is carried out in the groin under local anaesthesia below the level of inguinal ligament and vascular assess is secured with a 5Fr sheath. A 4F cobra catheter is passed into the descending aorta with a 0.035'Terumo guide wire and withdrawn and made to form a Waltmayer loop and pulled down into the anterior division of internal iliac arteries and uterine arteries are catherised. Angiogram is performed to assess the course and calibre of the uterine arteries. Selective cannulations of the uterine arteries are performed using a microcatheter and microwire 0.018". Embolisation of uterine artery is performed most commonly using PVA particles of 300-500 microns size.Alternatively gel form can also be used. End point of embolization is slowing of forward flow of contrast with a characteristic pruned tree appearance of vessels. The procedure is repeated on the contralateral side. DSA is performed in the end to assess the post embolization results. Other embolic agents that can be used are gelforms for temporary embolization and nitinol coil for permanent embolization.

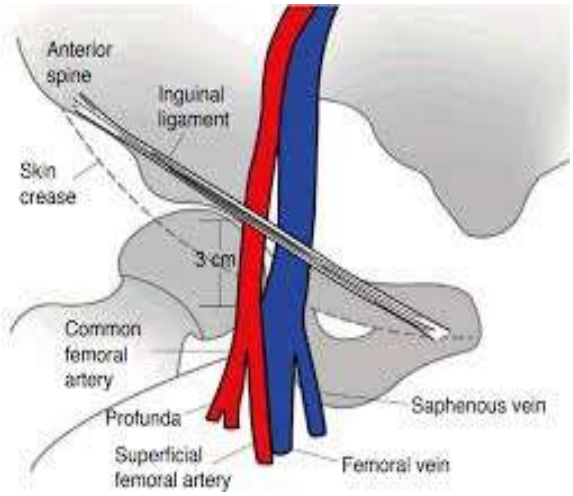

Fig 5: Graphical representation of the site for femoral artery puncturesin uterine artery embolization below the inguinal ligament on the medial aspect of femoral head.

Fig 6: Photograph of the 300 microns Cook's PVA Particles (Washington USA) used in embolization available in powder form.

Post operative care.

Pressure is applied to the femoral puncture site for 20minutes and tight compressive dressing given to prevent hematoma formation. Alternatively closure devices or Angioseal can be used. The limb is immobilised for 12 hours. The patient is monitored for 6hrs and then discharged. Post procedure analgesics and antibiotics are continued to combat pain and prevent infection following fibroid necrosis.

Complications following UAE is rare. Dissection of uterine arteries is rare and is usually due to poor technique. Puncture site complications include hematoma and pseudoaneurysm formation. Post embolization syndrome includes nausea vomiting fever lower abdominal pain following embolization of large fibroids due to endovascular release of cytokines and interleukins. These patients often have elevated ESR and leucocytosis and they settle with NSAID's. Ovarian failure and Amenorrhea are rare following embolization and seen in 10-20 percent of cases. Post procedure pelvic vein thrombosis and pulmonary embolism was seen in 2-4% of cases.

Following embolization the fibroids tend to undergo aspetic necrosis and tend to reduce in size. Good response is 50 percent reduction in fibroid volume 6months post procedure with lack of contrast uptake. Uterine artery embolization seems to have no effect on fertility and 50 percent of women conceive successfully after bilateral embolization.

Post Procedure Pain Management.

Patient counselling and active pain management may contribute to safe and successful patient outcome, without increasing complications. A standing regimen for pain including superior hypogastric nerve block (SHNB) is a very effective way to reduce pain after UAE especially within the first few hours. SHNB is performed by advancing a 21G needle from the abdominal wall below the umbilicus to the anterior portion of the fifth lumbar vertebral body with a cranio-caudal tilt of 5°–15° and injecting 20 mL local anaesthesia.

Other conditions for which uterine artery embolization is performed is to control post partum haemorrhage which is defined as blood loss of more than 500ml following normal vaginal delivery and 1000ml following caesarean sections. PPH can be classified as atonic due to poor contraction and involution of uterus and traumatic due to severe cervical and vaginal lacerations following difficult delivery of fetal head. UAE can be used to control bleeding from ectopic cervical pregnancy before administration of methotrexate.

Adenomyosis is a condition that affects perimenopausal women characterised by presence of ectopic endometrial glands within 2high power fields within the myometrium. Women with this disease usually have a uniformly bulky uterus with heterogeneous myometrium and present with dysmenorrhea, dyspareunia and menstrual irregularities. UAE has been found to give symptomatic relief to patients with adenomyosis and is a useful adjunct to medical management in women who are not fit to undergo hyeterectomy.

Extension to paediatric cases – UAE beyond fibroid embolization.

UAE is a novel treatment option for young females in paediatric age group who suffer from severe menorrhagia secondary to low platelets or abnormal platelet dysfunction and those who fail to respond to medical therapy. Bilateral UAE has helped these patients to recover from severe anemia due to blood loss and preserve their uterus and fertility. Here we present three cases done in our institute for Von Wilebrand disease, Idiopathic thrombocytopenia purpura, Dengue haemorrhagic fever and aplastic anaemia with myelodysplastic syndrome.

Case 1.

A 14 year old girl from Bangladesh was referred to us in a state of haemorrhagic shock with complaints of excess uterine bleeding since menarche. The current episode of bleeding lasted for about 20 days and she has to change almost 12 pads per day. Patient was evaluated in a local hospital in Dhaka Bangladesh where she was found to have low haemoglobin of 4gm/dl and Platelet count of 40000.

Systemic examination of the female was unremarkable there was no hepatosplenomegaly or lymphadenopathy. Laboratory investigations revealed a low haemoglobin and low platelets. Peripheral smear showed microcytic hypochromic anaemia with markedly reduced platelets and pancytopenia. PT and INR were normal. Bone marrow examination revealed hypocellular marrow with absent megakaryocytes. Provisional diagnosis of Aplastic Anaemia with progression to myelodysplastic syndrome was made.

Transabdominal ultrasound of the pelvis was performed which shows a bulky uterus with hyperechoic blood clot within the endometrial cavity. The patient was resuscitated by the paediatric emergency physician and the medical management for control of bleeding was performed which failed. The interventional radiology team was called into evaluate.

The child underwent emergency bilateral uterine artery embolization. There were hypertrophied uterine arteries which were embolized with 300-500 microns PVA particles. The patient was monitored in the PICU and blood transfusion given. The menstrual bleeding stopped within 4 days of procedure. The child underwent bone marrow transplantation later.

Case 2.

An 11 year old girl was admitted in paediatric intensive care unit with history of severe fever for last 5 days associated with chills and rigors. The child had her menstrual cycles 5 days back and was bleeding heavily since the last 2 days with passage of clots. There was a petechial rash mainly on the extensor surface of the lower limbs. Physical examination of the child was unremarkable. Laboratory investigations revealed low platelet count of 60000 with prolonged bleeding time. Peripheral smear and PT/INR was within normal limits. Serology test shows Dengue IgM card test to be positive. A provisional diagnosis of Dengue Hemorrhagic fever was made. The IR team was called to intervene when medical management failed to control menstrual bleeding.

We performed bilateral uterine artery embolization with PVA particles and the bleeding stopped immediately. The child later made a full recovery from Dengue fever.

Fig 7: Angiogram depicting the anterior division of right internal iliac artery along with the medially oriented tortuous course of uterine artery. The cork screw pattern and the prominent branches indicates significant hormone induced hypertrophy of the vessel.

Fig 8: Fluroscopic image in AP projection demonstrates PVA particles along with dilute contrast being selective injected into the right uterine artery via microcatheter. The large contrast blob posterior to the uterine artery is the contrast flow through the right ureter in the background.

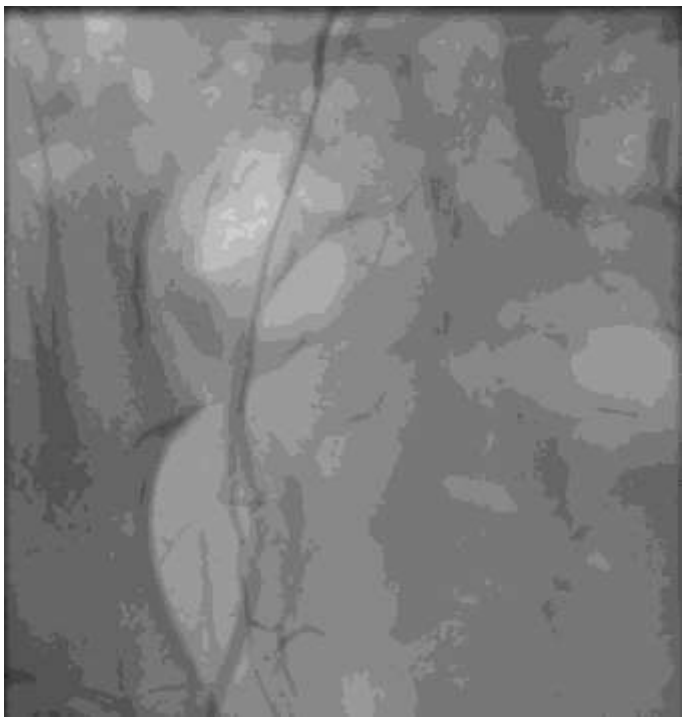

Fig 9: Post Embolization contrast run of the right internal iliac artery demonstrates complete occlusion of the hypertrophied uterine branches following injection of PVA particles.

Fig 10: Angiogram of a young female depicting the anterior division of the left internal iliac artery along with the tortuous course of hypertrophied uterine artery branches.

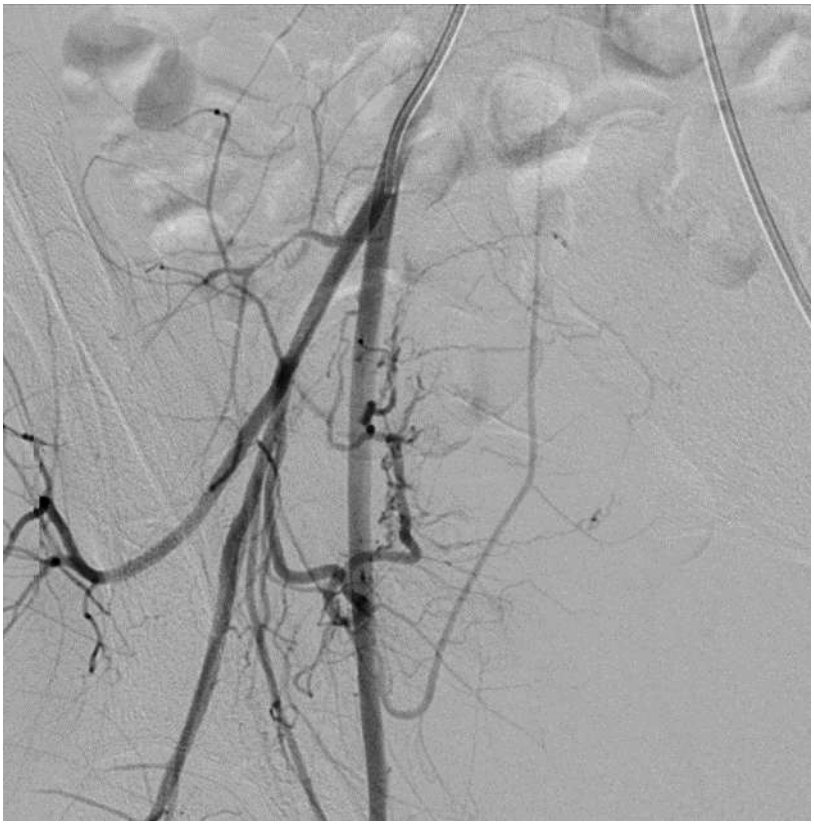

Fig 11: Digital Subtraction angiogram of a 15 year old girl demonstrating the uterine artery originating from the anterior division of internal iliac artery along with its tortuous cork screw branches towards the myometrium. The uterine artery follows a horizontal course till the internal os at the level of the ischial spine above the ureter and then ascends vertically along the parametrium supplying arcuate branches to the myometrium. The ascending lumbar, inferior and superior gluteal artery can also be made out.

Case 3:

A 12 year old girl presented to us with intermittent heavy menstrual bleeding and irregular cycles since menarche. She was diagnosed to have Von Willebrand's disease. On examination her vitals were stable. Pallor was present along with hepatosplenomegaly. Ultrasound of the pelvis shows a normal sized uterus with endometrial thickness of 5mm and minimal fluid within the endometrial cavity. The patient was found to have normal platelet count with prolonged bleeding and clotting time. PT was 12 sec and INR 1.2. The patient underwent successful bilateral uterine artery embolization with bland Cooks 300-500 micron particles. The post procedure period was uneventful and she made a speedy recovery.

Case 4:

The final case includes that of an 11 year old young girl from Mauritius who presented to our institute with Idiopathic Thrombocytopenic purpura. She had multiple episodes of uncontrolled menstrual bleeding since menarche. She also had hemoptysis and hematuria occasionally. She was moderately built and nourished with no pallor, jaundice, edema or lymphadenopathy. A form of palpable purpuric spots were seen on the back of trunk and in lower extremities. Systemic examination and blood counts were unremarkable. Pelvic ultrasound shows a uterine size normal for age. She underwent successful bilateral uterine artery embolization with no post procedure complications or morbidity.

II. Discussion.

Uterine artery embolization has a novel minimally invasive bloodless option for control of symptomatic fibroids with the added advantage of preservation of fertility. It causes aseptic necrosis of all fibroids simultaneously. In paediatric population though the applications are limited in our experience it has been found to be a useful alternative to hysterectomy in control of life threatening hemorrhage in certain special situiation's like Von Willebrand's disease, Idiopathic Thrombocytopenic purpura and Myelodysplastic syndrome. In our case series we have not had any adverse outcomes of the procedure. Most patients tolerate the procedure well and no mortalities were noted. The femoral puncture site bleeding usually subsided with manual

compression for 20minutes and no closure devices were used. Uterine artery embolization does not seen to have any adverse effects on fertility.

III. Conclusion:

There is immense potential for Uterine artery embolization in paediatric population to control life threatening menstrual bleeding without the need for hysterectomy. It is safe rapid and minimally invasive interventional procedure with a low level of mortality and morbidity. The procedure should be planned after discussing the pros and cons with the concerned gynaecologist and parents.

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