ORIGINAL ARTICLE

Pelvic Arterial Embolization for the Control of Intractable Pelvic Hemorrhage: Retrospective Analysis of 13 Cases

Nigar Sadaf[1], Rubina Hussain[2], Anjum Afhan[3], Samina Kamal[4], Aliya Waheed[5]

ABSTRACT

Background: Obstetric hemorrhage is one of the most important causes of maternal mortality. Severe postpartum hemorrhage is known to raise the mortality rate. There is a higher incidence of death from obstetric hemorrhage in developing countries as opposed to developed countries

Objective: To emphasize the role of interventional radiology in the management of obstetric and gynaecological haemorrhage in under developed countries like Pakistan.

Methods: The retrospective data of all patients requiring pelvic artery embolization for the control of pelvic hemorrhage was studied at Ziauddin University Hospital during the period from April 2011 to June 2014. Main outcome measure was the effectiveness to control hemorrhage. Technical success was defined as the cessation of bleeding on the post embolization angiogram and cessation of vaginal bleeding at speculum inspection performed immediately after PAE. Clinical success was said when the bleeding stopped completely after the first course of PAE and no additional PAE or surgery was required.

Results: A total of 13 patients underwent pelvic artery embolization (PAE) during this period. Five patients had primary postpartum haemorrhage (PPH), in which 3 patients had PPH after caesarean sections, one due to uterine atony secondary to triplets delivery, second had placenta praevia and third had placenta accreta. Two patients had uterine rupture, one following the normal vaginal delivery & other had previous 2 caesarean sections, uterine scar ruptured at 28 weeks of gestation. Two patients had secondary PPH, one due to uterine artery pseudo aneurysms after caesarean section and other had normal vaginal delivery. Six patients underwent pelvic artery embolization due to gynaecological cause i.e. heavy menstrual bleeding & pain secondary to fibroids. One patient had total abdominal hysterectomy and bilateral salpingoopherectomy due to fibroids but she continued to have bleeding from vaginal vault .Laparotomy was done twice but she continued to bleed so finally underwent pelvic arterial embolization after which bleeding stopped. All patients underwent selective embolization of the uterine artery or

[1] **Nigar Sadaf**

Assistant Professor, Department of Obstetrics & Gynecology, Ziauddin University & Hospitals, Karachi.

[2] **Rubina Hussain**

Chairperson & HOD, Department of Obstetrics & Gynecology, Ziauddin University & Hospitals, Karachi.

[3] **Anjum Afshan**

Associate Professor, Department of Obstetrics & Gynecology, Ziauddin University & Hospitals, Karachi.

[4] **Samina Kamal**

Department of Obstetrics & Gynecology, Ziauddin University & Hospitals, Karachi.

[5] **Aliya Waheed**

Department of Obstetrics & Gynecology, Ziauddin University & Hospitals, Karachi.

anterior divisional branch of the internal iliac artery with successful haemorrhage control and no immediate complications. PAE when done, in Gynae patients with fibroid resulted in severe abdominal pain immediately after the procedure for which analgesic medicines were given and the pain settled. These patients were followed in clinics and found to have significant decrease in their symptoms like 88% reduction in menorrhagia &100% improvement in pain in six months period after procedure. Imaging scans were also done to follow the size of fibroid that were found reduced 17-63%.

Conclusion: Selective pelvic embolization is a safe and effective treatment for acute obstetric or gynaecological haemorrhage and should be part of the management algorithm for PPH and for the treatment of symptomatic fibroids in females who especially want to conserve their uterus.

KEY WORDS: *Uterine Artery Embolization, Postpartum Haemorrhage, Fibroid.*

Cite as: Sadaf N, Hussain R. Pelvic arterial embolization for the control of intractable pelvic hemorrhage: Retrospective analysis of 13 cases. Pak J Med Dent 2014; 4(4):54-63.

INTRODUCTION

In obstetrics and gynaecology, when patients developed life threatening intractable pelvic haemorrhage and not responding to routine medical and conventional treatments for the control of bleeding then angiographic embolization is found to be highly effective in saving the life of patients.[1,2] Currently treatment options for the control of intractable pelvic bleeding include bilateral internal illiac artery ligation, hysterectomy and uterine artery embolization (UAE).Leading cause of mortality and morbidity in most of the disorders of female genital tract is pelvic and genital tract bleeding and transcatheter pelvic artery embolization (PAE) has commenced as a highly prudent percutaneous technique for the control of obstetric and gynecologic haemorrhage.[3]

Obstetric haemorrhage remains one of the most important causes of maternal mortality and severe postpartum haemorrhage is responsible for approximately 25% -30% of maternal deaths worldwide.[4,5] In developing countries the incidence of maternal mortality is approximately 1 in 1000 deliveries, whereas the incidence in developed countries is only around 1in 100,000 deliveries.[6] Postpartum haemorrhage is traditionally defined as bleeding of more than 500ml within 24 hours after normal vaginal delivery and more than 1000 ml after caesarean section.[7,8] Increasing incidence of PPH in developing countries is due to increase number of pregnancies in advanced age ,induction of labour, caesarean section rates and multiple pregnancies in recent years.[9,10] Traditionally, obstetricians have used various conservative methods to manage primary PPH which include uterine message, uterine packing, administration of uterotonic agents, and transfusion. Surgery remains an option for those, refractory to conservative treatment. However, during the past 2 decades, pelvic arterial embolization (PAE) has been shown to be a safe and effective alternative to surgery[11,12] and is now quickly being accepted as the standard treatment for rapidly controlling acute obstetric haemorrhage in various clinical situation.[13]

Uterine artery pseudoaneurysm (UAP) is a rare but life-threatening complication of uterine surgery, especially in caesarean section (C/S).[14] This condition may result in secondary postpartum haemorrhage, which is defined as haemorrhage that occurs between 24 hours and 6-12 weeks after delivery.[15]

Fibroids or leiomyomas are the most common benign tumours of uterus with prevalence rate of about of 50% near menopause.[16] More than 50% of the fibroids are asymptomatic.[17] however they may result in heavy menstrual bleeding, pain of varying intensity and may even cause pressure symptoms, if very large in size .Some fibroids contribute to subfertility by interfering with implantation.[18] Different treatment options available include conservative management using medical treatment, uterine artery embolization and surgical treatment i.e.

myomectomy. Definite treatment is still hysterectomy but it carries significant morbidity and mortality. Several studies show the comparable results between myomectomy and UAE some even signify that UAE is better as it is safe and has shorter recovery time.[19]

METHODOLOGY

This retrospective study was carried out at the department of Obstetrics and Gynaecology at Ziauddin University and Hospital. Medical records and radiological images of all the women who underwent pelvic arterial embolization, from April 2011to June 2014 at our university because of the obstetric or gynaecological causes were retrospectively analyzed. Through hospital records, data of thirteen patients who had undergone embolization during this period were identified. Obstetric causes include five cases of primary postpartum haemorrhage and two cases of secondary postpartum haemorrhage while gynaecological causes include the cases of heavy menstrual periods and pain attributed to the fibroids.

Regarding obstetric cases, one woman was our booked case. She had caesarean section at our hospital due to triplets and had primary PPH secondary to uterine atony, whereas remaining six women were referred from other institutions that did not have either an intensive care unit or a vascular imaging unit. All cases were initially managed by usual obstetric maneuvers for the treatment of PPH. This included intravenous uterotonic agents, aggressive uterine massage, manual extraction of the placenta, examination and repair of genital lacerations, transfusion of blood products and often balloon tamponade. The decision to perform arterial embolization was made on the basis of active continuous bleeding despite conservative measures and surgical treatment. A consulting obstetrician was involved in the decision to perform embolization in all cases. Informed consent was obtained from patients after they and their family had received an explanation of the potential risks and benefits of procedure. Coagulation abnormalities and disseminated intravascular coagulopathy were present in all four cases and were corrected before the procedure by the administration of fresh frozen plasma, and platelets. Technical success was defined as the cessation of bleeding on the post embolization angiogram and cessation of vaginal bleeding at speculum inspection performed immediately after PAE while clinical success was said when the bleeding stopped completely after the first course of PAE and no additional PAE or surgery was required.

Related to the Gynae cases, six patients (Age range: 20-47 years) with sonographic diagnosis of uterine fibroids associated with menorrhagia and/or pelvic pain underwent pelvic artery embolization. Two women were unmarried girls & remaining were married & premenopausal women who had been seen by gynecologist and were assessed on the basis of medical history, physical examination and laboratory studies. The diagnosis of fibroids was confirmed by pelvic ultrasound. Pregnancy was excluded in married women and UAE was done within first 10 days of their menstrual cycle. Investigations done before procedure included complete blood count, PT, APTT, INR and serum creatinine. Before the procedure, all patients were given prophylactic broad spectrum antibiotics which were continued for 1week after procedure. All procedures were performed by interventional radiologists in angiography suite. Technique used in all patients, was single femoral access after applying local anaesthesia. Pelvic angiogram was done and bilateral UAE performed in all patients. During procedure if patient complained of pain injection Fantanyl was administered. After the procedure, punctured site was compressed manually to achieve hemostasis Almost all the patients had pain &vomiting after the procedure which was resolved with continuous parenteral administration of narcotics and antiemetics. Patients were kept under observation in hospital for 2 to 3 days.

All patients were discharged home on oral analgesics once they were clinically fine and were followed in OPD after 3 months & 6 months of UAE, for improvement in their symptoms i.e. pain and menorrhagia. Pain was said to be improved if its severity was minimized on the numerical rating scale by a scale of 2 while menorrhagia was believed to be better if the number of pads soaked per day was decreased by one third of pads used before. Imaging scan was done to assess the reduction in the number and size of fibroids. Results of follow up of all patients were retrieved retrospectively and were registered in detailed proforma. The proforma included the questions

that help in the assessment of improvement in patients' condition.

RESULTS

During the study period from April 2011 to April 2014, 13 patients underwent pelvic arterial embolization. 7 patients had obstetric causes and other 6 had gynaecological causes. Detailed characteristics of obstetric patients who underwent PAE are shown in Tab 1. Related to obstetric causes 1 patient was booked case and remaining 6 patients were referred from other centers which do not have ICU units or angiographic suite. 5 patients had primary PPH while 2 patients had secondary PPH. Cause of primary PPH in 1 patient who was a booked case, was uterine atony after caesarean section due to triplets. 2nd patient who was Gravida 8 Parity $_6{}^{+1}$ had caesarean section due to placenta praevia in some other center developed primary PPH, all conservative measures were done but bleeding didn't stop so referred to our hospital after uterine packing. Here she underwent PAE after which bleeding stopped. 2 patients had primary PPH due to ruptured uterus. One patient 34years old gravida 5 parity3^{+1} had previous 2 caesarean sections. This time she had preterm labour at 28 weeks of gestation resulting in uterine rupture. Other patient 28 years of age gravida 3 parity 2^{+0} had uterine rupture after normal vaginal delivery.

By the time these patients reached our hospital they were hemodynamically unstable &had lost more than 3 liters of blood. They were admitted in ICU, stabilized & transfused 6 units of pack cells & 6 units of fresh frozen plasma along with 6 units of platelets. Immediate laparotomy was performed. In first patient uterus was ruptured at the previous scar so uterus was repaired after delivering the fetus who was dead, uterine embolization was done due to persistent vaginal bleeding. While bleeding stopped she developed multi organ failure and died within 24 hours in surgical ICU. In second patient uterine rupture was so extensive that repair was not possible so proceeded to obstetric hysterectomy. Even after hysterectomy bleeding continued from vaginal lacerations therefore underwent pelvic arterial embolization. After surgery, selective cannulations of uterine arteries were not possible hence embolization of common illiac and internal illiac artery was done. Her haemodynamic status was remained stable under continuous perfusion of epinephrine. Bleeding stopped & patient was fine.

Fifth patient 30 years of age $P_2{}^{+0}$ had caesarean section at some primary center due to previous 2 C/S, developed primary PPH due to placenta accreta and referred to our hospital after uterine packing with continued bleeding. Here she underwent pelvic artery embolization and bleeding stopped. Two women had pelvic artery embolization because of secondary PPH. One patient 35years of age parity3^{+1} had elective caesarean section due to previous two caesarean sections. After caesarean section she was fine &discharged home. At home she developed repeated episodes of heavy vaginal bleeding, dropping her haemoglobin to 3gm/dl. She went to hospital where caesarean was performed but they referred her to our hospital. After investigations she was found to have uterine artery pseudoaneurysm. Pelvic artery embolization was done & bleeding stopped. Second patient 25 years of age $P_1{}^{+0}$ had secondary PPH 10 days after normal vaginal delivery. She was fine after the delivery and discharged home on the second post natal day. On the 10th post natal day, all of a sudden she developed heavy vaginal bleeding with passage of clots. She went to same hospital where delivery took place. There conservative management was done along with uterine packing but bleeding continued so referred to our hospital. PAE was done and patient was fine. All patients were admitted in ICU and remain there for 2 days after embolization.

Table 1. Clinical Characteristics of Seven Obstetric Patients Who Underwent Pelvic Arterial Embolization

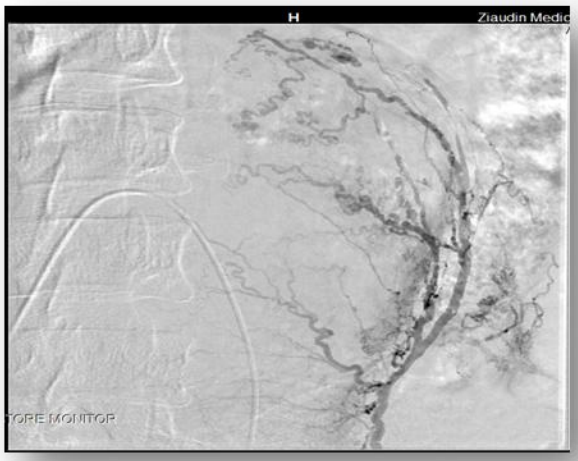
Case No.	Age Years	Parity	Gestat. Age (Weeks)	Mode of Delivery Indication	Est. Blood Loss (ml)	Etiology	Treatment Before Embol.	Arteries Embol.	Success

1	32	P_6+^3	38	Caesarean section	3500	Placenta Praevia	Conservative Uterine Packing	Uterine Arteries	Yes
2	28	P_2+^0	39	Normal Vaginal Delivery	3000	Uterine Rupture	Obstetric Hysterectomy	Internal Illiac Artery& Common Illiac arteries	Yes
3	30	P_0^{+0}	37	Cesarean Section due to Triplets	4000	Uterine Atony	B-Lynch	Uterine Arteries	Yes
4	34	P_3+^1	28	Caesarean Section Due to Previous 2C/S	4500	Uterine Rupture	Repair Of rupture	Internal iliac artery	Yes
5	34	P_3+^1	39	Caesarean Section Due to Previous 2C/S	1500	Uterine Pseudo Aneurysm	Conservative	Uterine Arteries	Yes
6	30	P_2^{+0}	37	Caesarean Section Due to Previous 2C/S	3500	Placenta Accreta	Conservative Uterine Packing	Uterine Arteries	Yes
7	22	P_1^{+0}	38	SVD	2500		Conservative Uterine Packing	Uterine Arteries	Yes

Fig 1: Internal Illiac artery Embolization in woman with PPH

Regarding gynaecological cases all six patients who underwent pelvic arterial embolization because of menorrhagia and pelvic pain secondary to fibroids, had technically successful embolization. The patients' age ranged between 20 to 47 years. Two patients were unmarried girls, one had multiple fibroids & other had single large fibroid. Both received medical therapy. One patient had myomectomy 3years ago with no symptomatic relief while other patient had total abdominal hysterectomy and bilateral salpingoopherectomy due to large fibroid causing multiple transfusions. She had persistent bleeding from the vaginal vault even after surgery, had laparotomy twice but bleeding didn't stop so in the last, underwent embolization of internal illiac vessels after which she was fine.

Fig 2: Uterine artery Embolization in woman with PPH



Two patients had multiple fibroids causing severe pain. Except for 2 patients who were unmarried, rests were married and premenopausal and were referred after complete investigations by gynaecologist. All patients had pain of varying degree after the procedure which was managed with parenteral opioids for 24 hours in hospital and with oral analgesics on discharge. One patient had fever for 2-3 days which settled with medication. No significant procedural complications were noted. Clinically patients were followed in OPD after 3 & 6 months which showed improvement in menorrhagia in 5(83.3%) out of 6 patients and 100% improvement in pain i.e. all patients reported improvement in pain. Reduction in number & size of fibroids was followed via imaging scan 6 months after UAE. Out of 6 patients 3 patients had significant reductions in fibroid size and 1 had complete disappearance. The results were assessed either as success or failure by improvement in course of symptoms upon clinical follow up and reduction in fibroid size based upon sonographic assessment (Table 2).

Table 2. Clinical Characteristics Of Six Gynae Patients Who Underwent Pelvic Arterial Embolization

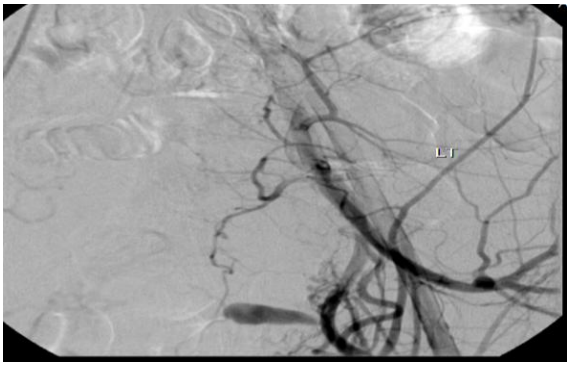
case	Age Years	Parity	Symptoms	Course
1	25	Unmarried	Menorrhagia & pain	Success
2	34	P_0^{+0}	Menorrhagia & pain	Success
3	37	P_0^{+0}	Menorrhagia & pain	Failure
4	43	P_0+^0	Dysmenorrhoea	Success
5	47	P_5^{+0}	Menorrhagia	Success
6	22	Unmarried	Menorrhagia	Success

Figure 3. Uterine artery Embolization in an unmarried girl with single large fibroid

DISCUSSION

Recently transcatheter arterial embolization has turned up as most worthwhile percutaneous approach for controlling acute and chronic uterine/pelvic hemorrhage in a multiple of obstetric and gynaecological conditions.[20,21] Plus points of UAE for the patients & health care providers include minimal complication rate, precluding the surgical risks, preserving the fertility, early recovery and shorter stay in the hospital. Retrospective analysis of 13 patients showed that PAE is safe and effective for women presenting with intractable pelvic haemorrhage. Its technical success rate is 100% Major complications that resulted in prolonged hospitalization did not occur although two patients experience severe pain and fever.

Figure 4. Uterine artery Embolization in woman with multiple fibroids



PPH is a life threatening obstetric complication and its management presents a matter of paramount importance to an obstetrician. Conventionally when the conservative local measures failed in controlling the haemorrhage, these patients were treated with systematic devascularization i.e. bilateral internal illiac artery ligation or hysterectomy. Drawbacks of surgical treatments include need for general anaesthesia, surgical complications like ureteric injury, bleeding, infection, failure rate for internal iliac artery ligation and above all loosing fertility if proceeded to hysterectomy.[1] Although our studied population is small, but the technical success rate is 100% which is similar to that reported in other studies. [12,22,23] In our study, technical success was based on cessation of vaginal bleeding in addition to the angiographically successful embolization of uterine or internal iliac arteries.

There is a causal relationship between DIC and shock. This study which showed DIC to be a poor prognostic factor is consistent with that by Touboul et al[24], where haemodynamic shock was found to be with poor outcomes in 102 patients with life threatening haemorrhage. DIC is frequently associated with haemodynamic instability and substantially influences patient outcome after a failed surgical procedure is associated with favorable clinical outcome in this study. Sentilhels et al[25] reported successful PAE performed in 12 of 13 patients with failed surgery including hysterectomy and hypogastric artery ligation and concluded that prior failed surgery was not associated with clinical failure of PAE. Fargeaudou et al[26] reported PAE in 12 patients after failed arterial ligation in which PAE was successful in 11 patients. In this study 2 patients had PAE after hysterectomies with 100% clinical success. It follows therefore that PAE can be considered for hemodynamically unstable patients with persistent bleeding after a failed surgical procedure .

In our study, regular menstruation returned after embolization for all patients who did not undergo hysterectomy, although with a reduced amount of menstrual bleeding during our short term follow-up of up to 10 months. Collateral circulations help to maintain the tissue viability.

20-40% of women in the reproductive age group presents with uterine leiomyoma which is found to be major health hazard worldwide. The symptoms vary from abnormal bleeding to pain and pressure symptoms.[27] The definite treatment of uterine fibroid is hysterectomy which is performed in about 20-30% of cases[28] especially in those females who have completed their family, the dilemma is in the young patients who have not completed their family and risk of recurrence is high with conservative surgical treatment i.e. myomectomy or the use of gonadotrophin releasing hormone agonist. Studies show that risk of recurrence of fibroid is significant 20-30% after myomectomy[29] that is similar to our study in which one woman presented with recurrence of fibroid & its symptoms after myomectomy. In the past, UAE has been described as a replacement to invasive surgical procedures but now in the West it is the recognized procedure with its success beyond the doubt, in reducing the heavy menstrual bleeding & controlling the bulk related symptoms secondary to uterine fibroids.[30]

The way UAE works, constitute blocking the vessels with embolized particles, decreasing blood flow to fibroid and causing the irreversible ischaemia which leads to necrosis and shrinkage. Because of having collaterals the normal myometrium, however, recovers well from this ischaemic event.[31]

In Pakistan this procedure is being performed in limited centers during recent years. Numerous former studies have reported 75-80% betterment in the symptoms of patients with fibroids, after being treated with UAE with success even in patients having huge &multiple fibroids.[32,33] The results of this study showing 100% improvement in pain and 88% improvement in menorrhagia are similar with other studies. This is shown in Table 3.

Table 3. Comparison of post UAE improvement in menorrhagia and pelvic pain published in different single center studies.

Author	Patients	Improvement in Menorrhagia	Improvement in pelvic pain
Messina et al.10	26	87.5	84.2%
Worthington-Kirsch et al.	53	88%	94%
Prolius et al.12	61	90%	88%
Goodwin et al	59	81%	81%

UAE in patients wishing to conserve their fertility has been questionable. In accordance with a review published in 2004, till additional data is available, the standard of care in patients with fibroids wishing to conserve their fertility, constitute laparoscopic myomectomy, open myomectomy or hysteroscopic resection.[34] The presence of multiple interstitial and /or submucous fibroids make such cases much more difficult and also increases the recurrence rate which may be more than 60%.[35] In UAE all fibroids are affected by single procedure that makes UAE more advantageous over myomectomy. The fibroids get smaller and in some even pass out vaginally.[36] There are limited studies available which show the same fertility rates after UAE in contrast to myomectomy [37].Prior studies are also available indicating that patients can conceive and have favorable pregnancy outcome after UAE.[36]

This study has certain limitations; firstly its retrospective nature, a small sample size and is a single center study. Secondly compliance of patients regarding follow up was sub optimal as well as period of follow up for 1 year is too short and therefore long term clinical data is not available. Pelvic artery embolization appears to be a reasonable alternative to traditional surgical procedures but its definite role in local population can only be ascertained after another multicenter study with larger patient population

CONCLUSION

In conclusion, to a large extent the impact of transcatheter arterial embolization is outrageous in controlling the intractable pelvic haemorrhage with minimal complication rate. The merits of transcatheter arterial embolization are the precise location of bleeding source and its focused haemostasis in a minimally invasive manner. Furthermore if the UAE failed and the bleeding continued or recurs it does not prevent from other surgical treatments. One of the most cardinal benefit of UAE is the possible conservation of fertility by avoiding hysterectomy and therefore saving the uterus. So in hospitals where compatible and skilled personnel and high technology are accessible transcatheter arterial embolization should be the innate part in the emanate management of pelvic haemorrhage. In obstetrics and gynaecology some researches have already been carried out using embolization for the control of intractable pelvic haemorrhage. Our center showed the results which are much better than other reported studies Table 4.

Table 4: Comparator studies for embolization in obstetrics and gynecology practice

Author	Journal	No of patients	Success rate (%)
Greenwood et al.	Radiology 1987;164: 155-9	08	100
Pelage et al.	Acta Obstet Gynecol Scand 1999; 78: 698-703.	27	92
Chung et al.	J Reprod Med.2003 April; 48 (4):268-76	33	94
Ojala et al.	Acta Obstet Gynecol Scand 2005; 84: 1075-1080.	22	77
Present Study	2014	13	100

REFERENCES

[1] Ojala K, Perälä J, Kariniemi J, Ranta P, Raudaskoski T, Tekay A. Arterial embolization and prophylactic catheterization for the treatment for severe obstetric hemorrhageFNx01. Acta Obstet Gynecol Scand 2005; 84:1075-1080.

[2] Chung JW, Jeong HJ, Joh JH, Park JS, Jun JK, Kim SH. Percutaneous transcatheter angiographic embolization in the management of obstetric hemorrhage. J Reprod Med 2003; 48:268-276.

[3] Onder C, Seyma H, Kaya S. Uterine artery embolization. Indian J Radiol Imaging 2002;12:67-69

[4] Al-Zairqi, Vargen S, Forsen L, Stray Pederson B. Prevalence and risk factors of severe obstetric haemorrhage. BJOG 2008 ; 115(10): 1265-1272

[5] Camuzcuoglu H, Toy H, Vural M, et al. Internal iliac artery ligation for severe postpartum haemorrhage and severe haemorrhage after postpartum hysterectomy. J Obstet Gynaecol Res 2010; 36: 538-543.

[6] Kim TH, Lee HH et al. Uterine artery embolization for primary postpartum haemorrhage.

Iran J Repro Med 2013; 11: 511-518.

[7] Cengiz H, Yassar L, Ekin M, et al. Management of intractable postpartum haemorrhage in a tertiary center: A 5 year experience. Niger Med J 2012; 53:85-88.

[8] Gronvall M, Tikkanen M, Tallberg E, et al. Use of Bakri balloon temponade in the treatment of postpartum haemorrhage: a series of 50 cases from tertiary teaching hospital. Acta Obatet Gynecol Scand. 2013; 92: 433-438.

[9] Sheikh I, Najmi N, Khalid U, Saleem T. Evaluation of compliance and outcomes of a management protocol for massive postpartum haemorrhage at a tertiary care hospital in Pakistan. BMC Pregnancy Childb 2011; 13: 11-28

[10] Knight M, Challaghan WM, Berg C, et al. Trends in postpartum haemorrhage in high resource countries: a review and recommendations from the International Postpartum Haemorrhage Collaborative Group. BMC Pregnancy Childb 2009; 27: 9-55.

[11] Gonsalves M, Belli A. The role of interventional radiology haemorrhage. Cardiovasc Interv Radiol 2010; 33(5): 887-895.

[12] Kirby JM, Kachura JR, Rajan DK, et al. Arterial embolization for primary postpartum haemorrhage. J Vasc Interv Radiol 2009; 20(8): 1036-1045.

[13] D. E. Eason and R. A. Tank. Avoidable morbidity in a patient with pseudoaneurysm of uterine artery after caesarean section, Journal of Clinical Ultrasound 2006; 34(8): 407-411.

[14] ACOG Practice Bulletin, "Clinical Management Guidelines for Obstetrician-Gynecologists number 76, October 2006: Postpartum haemorrhage," Obstetrics and Gynaecology2006; 108: 1039

[15] Lee HY, Shin JH, Kim J, et al. Primary Postpartum Hemorrhage: Outcome of Pelvic Arterial Embolization in 251 Patients at a Single Institution. J Radiology 2012; 264(3): 903-909

[16] Van den Bosch T, Coleman A, Morina M, Timmerman D, Amant F. Screening for uterine tumours. Best Pract Res Clin Obstet Gynaecol 2012; 26: 257-266.

[17] Divakar H. Asymptomatic uterine fibroids. Best Pract Res Clin Obstet Gynaecol 2008; 22: 643-654.

[18] Uba FA. Uterine fibroids: which treatment? Niger Med J 2011; 52:149.doi:10.4103/0300-1652.86122.

[19] Narayan A, Lee AS, Kuo GP, Powe N, Kim HS. Uterine artery embolization versus abdominal myomectomy: a long-term clinical outcome comparison. J Vasc Interv Radiol 2010; 21:1011-1017.

[20] Tandon P, Kumar S, Mohan Bishav. Angiographic embolization for intractable obstetrical bleeding. Web publication 2014; 4:(1):25-27

[21] Borgatta L, Chen AY, Reid SK, et al. Pelvic embolization for treatment of haemorrhage related to

spontaneous and induced abortion. Am J Obstet Gynaecol 2001; 185: 530-536.

[22] Boulleret C, Chahid T, Gallot D, et al. Hypogastric arterial selective and super selective embolization for severe postpartum haemorrhage: retrospective review of 36 cases. Cardiovasc Intervent Radiol 2004; 27 27(4):344-348.

[23] Diop AN, Chabrot P, Bertrand A, et al. Placenta accreta: management with uterine artery embolization in 17 cases. J Vasc Interv Radiol 2010; 21(5):644-688.

[24] Touboul C, Badiou W, Saada J, et al. Efficacy of selective arterial embolization for the treatment of life-threatening postpartum haemorrhage in a large population. PLoS ONE 2008;3(11):e3819.

[25] Sentilhes L, Gromez A, Clavier E, Resch B, Verspyck E, Marpeau L. Predictors of failed pelvic arterial embolization for severe postpartum hemorrhage. Obstet Gynecol 2009;113(5):992–999.

[26] Fargeaudou Y, Morel O, Soyer P, et al. Persistent postpartum haemorrhage after failed arterial ligation: value of pelvic embolization. Eur Radiol 2010; 20(7):1777–1785.

[27] Goodwin SC, Spies JB, Worthington-Kirsch R, et al. Uterine artery embolization for treatment of leiomyomata: long-term outcomes from the FIBROID Registry. Obstet Gynecol. 2008; 111(1):22–33. [PubMed]

[28] Pinto I, Chimeno P, Romo A, et al. Uterine fibroids: uterine artery embolization versus abdominal hysterectomy for treatment--a prospective, randomized, and controlled clinical trial. Radiology.2003; 226(2):425–31. [PubMed]

[29] Rossetti A, Sizzi O, Soranna L, et al. Long-term results of laparoscopic myomectomy: recurrence rate in comparison with abdominal myomectomy. Hum Reprod. 2001; 16(4):770–4. [PubMed]

[30] Pron G, Mockarski E, Cohen M, Colgan T, Bennet J, Common A, et al. Hysterctomy for complications after uterine artery embolization for uterine leiomyoma: results of a Canadian multicenter clinical trial. J Am Assoc Gynecol Laparosc 2003; 10: 99-106.

[31] Tropeano G, Amoroso S, Scambia G. Non-surgical management of uterine fibroids. Hum Reprod Update. 2008; 14(3):259–274. [PubMed]

[32] Rehman IU, Haq TU, Hamid RS, Azeemuddin M, Akhtar W, Kanwal D. Uterine artery embolization for the treatment of uterinefibroids: initial experience. PJR 2011; 21: 1-5.

[33] Walker WJ, Baron-Smith P. Long term follow up of uterine artery embolization - an effective alternative in the treatment of fibroids. BJOG 2006; 113: 464-468.

[34] Olive D, Lindheim S, Pritts E. Non-surgical management of leiomyoma: impact on fertility. Curr Opin Obstet Gynecol 2004; 16: 239-243.

[35] Hanafi M. Predictors of leiomyoma recurrence after myomectomy. Obstet Gynecol 2005; 105: 877-881.

[36] Jha RC, Ascher SM, Imaoka I, Spies JB. Symptomatic fibro leiomyomata: MR imaging of the uterus before and after uterine arterial embolization. Radiology 2000; 217: 228-235.