Clinical evaluation of preoperative abdominal aortic balloon occlusion in patients with placenta increta or percreta

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Abstract

Background Placenta increta or percreta will result in severe postpartum hemorrhage and become a research hotspot in obstetrics. Preoperative abdominal aortic balloon occlusion (AABO), as a new intravascular interventional therapy, has taken more and more attention in obstetrics. Thus, the aim of this study is to evaluate the safety and efficacy of abdominal aortic balloon occlusion. Methods Retrospective analysis of pregnant women with placenta increta or percreta delivered between January 2013 and April 2019 in the Sichuan Provincial People's Hospital. The experimental group (AABO group) included 168 patients who underwent abdominal aortic balloon occlusion before cesarean section. The control group (NO-AABO group) was composed of 106 patients who underwent surgery without any preoperative intravascular interventional therapy. The parameters containing estimated blood loss, red cell suspension (RCS) transfusion volume, hysterectomy, surgery time, postoperative hospital days, neonatal status and complications were compared between the two groups. Results The patients with preoperative abdominal aortic balloon occlusion had significant reduction in blood loss volume, red cell suspension transfusion volume and plasma transfusion volume compared to patients without balloon. Similarly, the surgery time and hysterectomy were obviously reduced in AABO group. However, there were no differences in the Apgar scores and neonatal complications between the two groups, indicating that the abdominal aortic balloon has little adverse effect on the newborns. Conclusion AABO is a safe and effective technology for pregnant women with placenta increta or percreta to reduce blood loss volume and blood transfusion volume.

Background

With the increases of cesarean section rate globally, the incidence of morbidly adherent placenta (MAP) during second pregnancy has increased significantly. [1] MAP is classified into three types according to the depth of invasion; placenta accreta, a morbid attachment of the placental villi to the surface of the myometrium; placenta increta, the placental villi implant into the myometrium and even penetrate it; and placenta percreta, the placental villi penetrate the myometrium and reach or exceed the uterine serosa. [2] Morbidly adherent placenta (MAP) is a severe obstetrical complication which can lead to postpartum hemorrhage, kidney and liver damage, disseminated inravascular coagulation (DIC), shock and even life-threatening. Machado et al. reported that MAP has replaced uterine atony as the main cause of hysterectomy. [3, 4]

Placenta increta or percreta often occurs in pregnant women with placenta previa and a history of previous cesarean section. In China, the rate of cesarean section is nearly 50%, and many women want to have a second child, especially with the introduction of the second child policy. Therefore, placenta previa complicated by placenta increta/percreta has become common among women with a history of cesarean section. Previously, hysterectomy, which permanently affected fertility, following cesarean section was the main therapeutic choice when life-threatening bleeding occurred in women with placenta increta or percreta. In the past few decades, some interventional therapies, such as common iliac artery balloon, uterine artery embolization, have been used in obstetrics. [5-7]However, the efficacy of these therapies is limited because of the collateral circulation of the uterus.

In 1995,Paull et al. first reported a case with placenta percreta using abdominal aortic balloon occlusion before cesarean section to prevent intraoperative and postoperative hemorrhage.[8] In recent years, abdominal aortic balloon, as a new technology, has become more and more popular in women with placenta increta or percreta. [9, 10] To evaluate the efficacy and safety of this new technology, we collected relevant clinical data, together with previous articles, to make an analysis and summary. we collected data from patients with placenta increta or percreta who were treated in the Sichuan Provincial People's Hospital and make a comparison on blood loss volume、blood transfusion volume and hysterectomy rates between AABO group and NO-AABO group.

Methods

Patients

We conducted a retrospective analysis of pregnant women with placenta increta or percreta who were treated in our hospital between January 2013 and April 2019. Patients who met the inclusion and exclusion criteria were included in our research. The inclusion criteria were as follows: 1. Diagnosed as placenta increta or percreta based on MRI, and confirmed by intraoperative findings; (The diagnostic criteria were as follows: placenta increta: MR images revealed that the placental villi implanted into the myometrium. placenta percreta: MR images showed that the placental villi penetrated the myometrium and reached or exceeded the uterine serosa) 2.Without hemorrhage before surgery; 3.Gestational weeks≥28 weeks; 4.A history of previous cesarean section; 5. Placenta previa, and the placenta is located in the prior cesarean scar; 6. Preoperative hemoglobin≥100g/L。 The exclusion criteria were: 1. Severe obstetric complications especially hematological system diseases or coagulation disorders; 2.Use some drugs that will affect coagulation function, like aspirin; 3.Fetal anomaly or fetal growth restriction, fetal distress. All steps were completed by two individuals, and any disagreement was arbitrated by a third party. We collected clinical data of each patient, such as estimated blood loss, red cell suspension (RCS) transfusion volume, plasma transfusion volume and operative time from the electronic medical records system in our institution. We followed up the complications and menstruation by telephone and Email. The average follow-up time was 2 years.

Methods

All intravascular interventional therapies in AABO group were completed by senior interventional and obstetrical doctors. After local anesthesia, the right femoral artery was punctured using Seldinger technique for inserting a 12-F sheath (RCF-12.0-38-J, Cook Medical Inc., Bloomington, IN). And then a 10-F occlusion balloon catheter (CODA-10.0-35-100-32, Cook Medical Inc.) was inserted into the lower segment of the abdominal aorta beneath the opening of the renal arteries. After the fetus is delivered, the interventional doctors inflated the balloon immediately to block the blood supply of the uterine. This new technology can block the uterine blood supply temporarily when the surgeon manually removed the placenta and sutures the uterine incision. The blocking time was about 40 minutes, and the interval was 10 minutes. If the hemorrhage was continued, the blockage can be repeated once more until the bleeding stopped. Patients were observed in the recovery room for 30min after cesarean sections finished.

In the NO-AABO group, cesarean sections were routinely performed by senior obstetrical doctors, and the operative methods like B-lynch suture, uterine artery embolization, uterine packing and uterine artery ligation were performed when massive hemorrhage occurred. If it was difficult to manually remove the placenta, we left the placenta in situ and performed hysterectomy directly.

Main outcome measures

The main outcome parameters include estimated blood loss volume, red cell suspension (RCS) transfusion volume, plasma transfusion volume, hysterectomy, operative time, the number of patients transferred to ICU, postoperative hospital days, neonatal status and complications.

Statistical analysis

The clinical data analyses were performed using SPSS 24.0 (IBM Corporation, Amon City, NY). Continuous variables with normal distribution were presented as mean±standard[1]deviation, and independent sample t-test was used to determining the differences. Categorical data were expressed as frequency and percentages with Chi-square test to compare the difference. P <0.05 was considered to be a statistical significance.

Results

A total of 274 patients were include in our study, in which 168 pregnant women accepted prophylactic use of abdominal aortic balloon occlusion and 106 women performed cesarean section without balloon. In AABO group, there were 98 patients with placenta increta and 70 patients with placenta percreta. Similarly, there were 72 patients with placenta increta and 34 patients with placenta percreta in the NO-AABO group. There was no significant difference in the types of placenta between the two groups.

As shown in Table1, there were no obvious differences in age, gestational weeks, gravidity, parity, prior cesarean section times, and abortion times between the two groups. The mean estimated blood loss volume (831ml vs.1468ml, P<0.05) and RCS transfusion volume (274ml vs.675ml, P<0.05) were obviously decreased in the AABO group compared with NO-AABO group. The plasma transfusion volume was 128ml and 308ml in the AABO and control group, respectively (P=0.003). Patients in the AABO group had an obvious reduction in surgery time compared with NO-AABO group (89min vs.101min, P=0.034).There was also a significant advantage in terms of hysterectomy in AABO group (23/168 vs.30/106, P=0.003). However, the differences in postoperative hospital stay (4.22d vs.4.51d, P=0.257), transfer to ICU (8/168 vs. 11/106, P=0.075) and postoperative uterine artery embolization (11/168 vs. 13/106, P=0.103) were not significant between the two groups (Table 2).

As for neonate, the mean Apgar scores at 1min, 5min and 10min were all<8,without obvious differences in the two groups(P>0.05). Similarly, there were no significant differences in neonatal weight (P=0.192) and asphyxia neonatorum (P=0.256) between the two groups (Table 3). As to complications, there were 7 and 3 patients infected in AABO and NO-AABO group, respectively. 7 patients in the control group and 4 in the AABO group developed hemorrhagic shock intraoperative. There were 1patient had incomplete intestinal obstruction and 1patient had pulmonary microembolization in the control group. And 1 patient in the AABO group was observed thrombus in superficial femoral artery and cured by low molecular heparin during the period of hospitalization (Table 4).

Among the 274 patients, there was no maternal or neonatal mortality, all puerperant and neonatus were healthy during follow-up.

Discussion

Morbidly adherent placenta often associated with severe hemorrhage, which can result in significant maternal and neonatal adverse outcomes.[3] Patients with placenta increta or percreta are more likely to appear uncontrollable hemorrhage, hysterectomy and increase susceptibility to life-threaten, [3, 4] despite the use of uterine tonic, intrauterine gauze packing, B-Lynch sutures and uterine artery ligation. Qinghua Wu et al. have reported that the average blood loss volume was 2790±335ml in patients with placenta increta when used traditional cesarean section without abdominal aortic balloon occlusion.[11] In our control group, we performed hysterectomy while leaving placenta in situ when realized the bleeding was uncontrollable or the placenta was difficult to manually remove. Thus, still, there were 30 (30/106=28.3%) patients with placenta increta or percreta be performed hysterectomy. In addition, we have multidisciplinary collaboration and new uterine tonic for women with MAP. Even so, the mean blood loss volume was about 1468 ml in these patients; almost two-thirds more than the AABO group

There have been some other intravascular interventional therapies. For example, some surgeons have attempted to place balloon catheters in the bilateral common iliac artery to block the uterine blood supply temporarily when obstetrician manually removes the placenta.[6] However, during late gestation, the abundant collateral circulation such as ovarian artery, external iliac artery and median sacral artery is involved in the uterine blood supply,[12, 13] the efficacy of these interventional therapies such as iliac artery balloon, uterine artery embolization is limited. Shrivastava et al. performed bilateral internal iliac artery balloon in patients with placenta increta, but the results were that the estimated blood loss volume and RCS transfusion volume did not decrease significantly.[14]

The blocking position of AABO is beneath the opening of the renal arteries, which can block the main blood supply of the uterus and do not cause ischemia to the vital organs in the abdominal cavity. So it is safer and has a better hemostatic effect. Some scholars have reported that there were obvious reductions in blood loss volume and RCS transfusion volume with AABO versus other interventional therapies like internal iliac artery balloon. [15-17] In our study, the patients with AABO preoperative had significant reductions in estimated blood loss, RCS transfusion volume and hysterectomy compared to patients without balloon. No patients had liver or kidney impairment. All women who ended breastfeeding have recovered their menstruation and there was no significant difference in menstrual volume or duration compared with before pregnancy. Similarly, Qinghua Wu et al. performed AABO in 230 patients and did not cause any damage to liver or kidney function.[11]

As for whether the X-rays will cause fetal damage, the International Commission on Radiological Protection (ICRP) suggests that when the radiation dose is under 100 mGy, the fetal teratogenic risk will not increase.[18] In our study, the exposure time was below 15s and the radiation dose was less than 10mGy, compared with internal iliac artery balloon, in which the radiation doses ranged from 21-61mGy.[19-21] No radiation-related neonatal complications occurred during the follow-up period. Qinghua Wu et al. has also reported that in their research the average exposure time was 8.3±3.9s and the mean radiation dose was 5.1±3.0mGy,[11] which is similar to other study with a time of 7.2±1.5s and a dose of 3.4±1.1mGy.[22] So the radiation dose of AABO is safe for fetus

The time of occlusion was after the fetus was delivered and before the placenta was removed, thus it has little influence on the blood supply of fetus. There is no unified standard for the total duration of balloon occlusion. One study has performed 80min of continuous occlusion in patients with placenta percreta during cesarean section and no obvious complication was observed.[23] Panici P B, et al. point out that the mean time of occlusion in their study was 32min(range25-39min) in 15 patients with placenta previa accrete or increta. No limb necrosis, thrombus or ischemia-reperfusion injury was observed postoperatively.[24] In our study, the mean time was 28min (range 20-36min).only 1 patient was observed the thrombus in superficial femoral artery and cured by low molecular heparin during the period of hospitalization. During the follow-up time after leaving hospital, nobody has thrombus, limbs ischemic necrosis, damage of liver or kidney function, or hypoesthesia of legs.

Conclusions

Placenta increta or percreta will result in severe postpartum hemorrhage. Preoperative abdominal aortic balloon occlusion (AABO), as a new intravascular interventional therapy, has taken more and more attention in obstetrics. It has a beneficial effect by reducing blood loss volume and blood transfusion volume. It is a safe and effective technology and should be promoted in patients with placenta increta or percreta.

Declarations

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Authors' contributions: Correspondence should be addressed to ZW; dexterwuzhao@126.com. ZW designed the study, collected all data and wrote the results. ZY was responsible for writing introduction and discussion. JM and YH were responsible for writing materials and methods. QD and MH performed data analysis. All authors read and approved the final manuscript.

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References

[1] Imudia A N, Awonuga A O, Dbouk T, et al. Incidence, trends, risk factors, indications for, and complications associated with cesarean hysterectomy: a 17-year experience from a single institution[J]. Arch Gynecol Obstet, 2009, 280(4): 619-623.

[2] Miller D A, Chollet J A, Goodwin T M. Clinical risk factors for placenta previa-placenta accreta[J]. Am J Obstet Gynecol, 1997, 177(1): 210-214.

[3] Kassem G A, Alzahrani A K. Maternal and neonatal outcomes of placenta previa and placenta accreta: three years of experience with a two-consultant approach[J]. Int J Womens Health, 2013, 5: 803-810.

[4] Machado L S. Emergency peripartum hysterectomy: Incidence, indications, risk factors and outcome[J]. N Am J Med Sci, 2011, 3(8): 358-361.

[5] Horng H C, Hu W M, Tseng H S, et al. Uterine arterial embolization in the management of severe post-partum hemorrhage: a successful rescue method to avoid peripartum hysterectomy[J]. J Chin Med Assoc, 2011, 74(6): 255-258.

[6] Shih J C, Liu K L, Shyu M K. Temporary balloon occlusion of the common iliac artery: new approach to bleeding control during cesarean hysterectomy for placenta percreta[J]. Am J Obstet Gynecol, 2005, 193(5): 1756-1758.

[7] Tan Y L, Suharjono H, Lau N L, et al. Prophylactic bilateral internal iliac artery balloon occlusion in the management of placenta accreta: A 36-month review[J]. Med J Malaysia, 2016, 71(3): 111-116.

[8] Paull J D, Smith J, Williams L, et al. Balloon occlusion of the abdominal aorta during caesarean hysterectomy for placenta percreta[J]. Anaesth Intensive Care, 1995, 23(6): 731-734.

[9] Chen M, Xie L. Clinical evaluation of balloon occlusion of the lower abdominal aorta in patients with placenta previa and previous cesarean section: A retrospective study on 43 cases[J]. Int J Surg, 2016, 34: 6-9.

[10] Sun W, Duan S, Xin G, et al. Safety and efficacy of preoperative abdominal Aortic balloon occlusion in placenta increta and/or percreta[J]. J Surg Res, 2018, 222: 75-84.

[11] Wu Q, Liu Z, Zhao X, et al. Outcome of Pregnancies After Balloon Occlusion of the Infrarenal Abdominal Aorta During Caesarean in 230 Patients With Placenta Praevia Accreta[J]. Cardiovasc Intervent Radiol, 2016, 39(11): 1573-1579.

[12] Palacios Jaraquemada J M, Garcia Monaco R, Barbosa N E, et al. Lower uterine blood supply: extrauterine anastomotic system and its application in surgical devascularization techniques[J]. Acta Obstet Gynecol Scand, 2007, 86(2): 228-234.

[13] Soyer P, Morel O, Fargeaudou Y, et al. Value of pelvic embolization in the management of severe postpartum hemorrhage due to placenta accreta, increta or percreta[J]. Eur J Radiol, 2011, 80(3): 729-735.

[14] Shrivastava V, Nageotte M, Major C, et al. Case-control comparison of cesarean hysterectomy with and without prophylactic placement of intravascular balloon catheters for placenta accreta[J]. Am J Obstet Gynecol, 2007, 197(4): 402.e401-405.

[15] Yang X, Chen Z, You Y. The Comparative Study in Perioperative Temporary Balloon Occlusion of the Distal Abdominal Aorta and Perioperative Temporary Balloon Occlusion of the Internal Iliac Arteries in the Therapy of Patients with Placenta Accreta[J]. Journal of Practical Obstetrics and Gynecology, 2016, 32(9): 684-688.

[16] Song P, Wu N. The application of temporary balloon occlusion technique in performing cesarean section for patients with pernicious placenta previa[J]. Journal of Interventional Radiology, 2017, 26(5): 451-454.

[17] Wang Y L, Duan X H, Han X W, et al. Comparison of temporary abdominal aortic occlusion with internal iliac artery occlusion for patients with placenta accreta - a non-randomised prospective study[J]. Vasa, 2017, 46(1): 53-57.

[18] The 2007 Recommendations of the International Commission on Radiological Protection. ICRP publication 103[J]. Ann ICRP, 2007, 37(2-4): 1-332.

[19] Kai K, Hamada T, Yuge A, et al. Estimating the Radiation Dose to the Fetus in Prophylactic Internal Iliac Artery Balloon Occlusion: Three Cases[J]. Case Rep Obstet Gynecol, 2015, 2015: 170343.

[20] Levine A B, Kuhlman K, Bonn J. Placenta accreta: comparison of cases managed with and without pelvic artery balloon catheters[J]. J Matern Fetal Med, 1999, 8(4): 173-176.

[21] Yi K W, Oh M J, Seo T S, et al. Prophylactic hypogastric artery ballooning in a patient with complete placenta previa and increta[J]. J Korean Med Sci, 2010, 25(4): 651-655.

[22] Cui S H, Zhi Y X, Zhang K, et al. [Application of temporary balloon occlusion of the abdominal aorta in the treatment of complete placenta previa complicated with placenta accreta][J]. Zhonghua Fu Chan Ke Za Zhi, 2016, 51(9): 672-677.

[23] Masamoto H, Uehara H, Gibo M, et al. Elective use of aortic balloon occlusion in cesarean hysterectomy for placenta previa percreta[J]. Gynecol Obstet Invest, 2009, 67(2): 92-95.

[24] Panici P B, Anceschi M, Borgia M L, et al. Intraoperative aorta balloon occlusion: fertility preservation in patients with placenta previa accreta/increta[J]. J Matern Fetal Neonatal Med, 2012, 25(12): 2512-2516.

Tables

Table1. Comparison of demographic characteristics in the two groups

Group	Total(n)	Placenta increta(n)	Placenta Percreta(n)	Age(y)	Gestation(d)	Gravidity(n)	Parity(n)	Prior cesarean(n)	Abortion(n)
AABO	168	98	70	31.58±4.432	260.13±7.95	4.18±1.708	1.14±0.368	1.12±0.343	2.04±1.718
NO-AABO	106	72	34	32.33±4.922	260.62±10.08	4.46±2.052	1.17±0.489	1.09±0.343	2.29±1.920
t test		2.539		-1.303	-0.354	-1.186	-0.549	0.782	-1.091
P value		0.111		0.194	0.724	0.237	0.584	0.435	0.276

Data are presented as mean±standard deviation or n (%).

Table 2.Comparison of the clinical data between the two groups

Group	Total(n)	Blood loss(ml)	RCS*transfusion(ml)	plasma transfusion(ml)	Surgery time(min)	Hospital stay(d)	ICU(n)	Embolization(n)	Hysterectomy(n)
AABO	168	831.02±640.75	274.76±456.48	128.27±300.182	89.02±38.520	4.22±1.636	8	11	23
NO-AABO	106	1468.30±1099.95	675.47±1038.48	308.49±569.062	101.64±52.707	4.51±2.319	11	13	30
t test		-5.408	-3.748	-3.007	-2.132	-1.137	3.176	2.658	8.894
P value		0.000	0.000	0.003	0.034	0.257	0.075	0.103	0.003

* Red cell suspension

Table 3.Characteristics of the newborns between the two groups

Group	Total(n)	1min	5min	10min	Weight birth(kg)	asphyxia neonatorum
AABO	168	8.36±1.255	9.61±0.674	9.91±0.306	2909.07±381.798	11
NO-AABO	106	8.73±1.676	9.71±0.804	9.86±0.524	2975.47±425.647	11
t test		-1.918	-1.047	0.930	-1.308	1.291
P value		0.057	0.296	0.354	0.192	0.256

Table 4.The complications in the two groups

Group	Total(n)	Infection(n)	Hemorrhagic shock(n)	intestinal obstruction(n)	Pulmonary embolism(n)	DIC(n)	Bladder injury(n)	Arterial thrombosis(n)
AABO	168	7	4	0	0	1	2	1
NO-AABO	106	3	7	1	1	1	3	0
t test		0.059	2.012					
P value		0.807	0.156					