

Internal Iliac Artery Occlusion Balloon Catheters to Minimize Blood Loss in Adherent Placenta: A Retrospective Cohort Study

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ABSTRACT

Adherent placenta is a rare but life- and fertility-threatening condition, with a rapid increase in incidence in this decade. Cesarean hysterectomy, the traditional management, is associated with very high morbidity due to massive blood loss and adjacent organ damage. The objective was to study the effect of preoperative internal iliac artery balloon catheter placement as a means of reducing morbidity.

Methods: Adherent placenta cases were identified using hospital database over a 9 years period from 2001 to 2009 at Fernandez hospital, a tertiary perinatal center with 5000 deliveries annually. Mothers who had preoperative internal iliac artery balloon placements were compared with those who did not have. Maternal morbidity was assessed in the form of intraoperative blood loss, total units of blood products transfused, mean operative time, length of postoperative hospital stay, use of adjuvant procedures (for control of hemorrhage), adjacent organ damage, cardiac arrest, and maternal mortality.

Results: Forty-one subjects with a diagnosis of adherent placenta were identified out of 32,354 deliveries (incidence of 1:789) and 27 of these had peripartum hysterectomy. Six had preoperative internal iliac artery balloons placement before hysterectomy (study group) and 21 had hysterectomy alone (control group). Significant difference was found in mean amount of blood loss ($p = 0.002$) and in mean number of blood products given ($p = 0.04$). No statistically significant difference was found in mean operative time and length of postoperative hospital stay. There were four subjects who had adjacent organ damage, two had cardiac arrest, two required recombinant factor VIIa in the control group when compared with none in the study group.

Conclusion: Preoperative placement of internal iliac artery occlusion balloon catheters reduced morbidity by minimizing blood loss and adjacent organ damage.

Keywords: Adherent placenta, Balloon catheters, Placenta accreta, Cesarean hysterectomy.

INTRODUCTION

Adherent placenta characterized by abnormal attachment of placental villi to uterine wall has always remained an obstetric challenge. It is a rare but life- and fertility-threatening condition associated with high maternal morbidity and mortality.¹ The incidence of adherent placenta has increased alarmingly from less than one in 30,000 in the 1950s through one in 2500 in the 1980s to one in 533 pregnancies in the year 2002.^{2,3} An increasing trend towards cesarean sections and uterine surgeries has contributed to this rise.⁴ Traditionally, cesarean delivery followed by hysterectomy is the mainstay of management of adherent placenta but a number of uterus preserving conservative measures have been described, like oversewing the placental bed, partial placental resection, leaving the placenta *in situ*, methotrexate, arterial ligation, selective arterial embolization and argon beam coagulation.⁵⁻⁷

A significant part of the maternal morbidity and mortality in adherent placenta is associated with surgical procedures, massive blood loss, blood transfusions, infection, and adjacent organ damage.¹ Despite advanced preoperative preparation, there can be catastrophic bleeding not amenable to current surgical techniques. Temporary placement of occlusive balloon catheters in both internal iliac arteries is a technique that aims to minimize blood loss. However, the procedure is not widely performed due to cost constraints besides the need for expertise and infrastructure support. We did a retrospective cohort analysis to determine the efficacy of preoperative internal iliac artery balloon catheterization in minimizing blood loss and transfusion requirements in peripartum hysterectomy for adherent placenta.

METHODS

We identified subjects for the study by a search of the maternal database at Fernandez Hospital, Hyderabad, Andhra Pradesh, India for the period from 2001 to 2009. Fernandez Hospital is an advanced tertiary care perinatal center that performs

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approximately 5000 deliveries annually; a significant proportion of these are high-risk pregnancies. Each pregnant woman undergoes an antenatal check by a standardized protocol including trimester specific ultrasound examinations for dating, structural malformations, fetal growth and well-being. The details of the antenatal and perinatal examinations are entered in a maternal database. The study protocol adhered to the tenets of the Declaration of Helsinki.

Subjects of our study included all women who underwent peripartum hysterectomy for adherent placenta (including two with mid-trimester abortions). These were further divided into two categories—those who had a pre-hysterectomy placement of occlusive balloon catheters in internal iliac arteries were included in the study group and those who had hysterectomy without such intervention formed the control group.

The diagnosis of adherent placenta was primarily based on intraoperative findings, such as thinned, ballooned, hypervascular lower uterine segment with complete placental invasion through uterine wall in cases of placenta percreta. But in women with risk factors for adherent placenta, antenatal diagnosis was made based on ultrasound features, such as loss of retroplacental hypochoic zone, multiple lacunar spaces in placenta, anterior myometrial thinning and irregularity, neovascularization of lower uterine segment and invasion into the bladder.

All diagnosed cases of adherent placenta were dealt with a multidisciplinary team involving obstetrician, gynecologist, anesthetist, and physician and intervention radiologist. The patient and her family were appropriately counseled regarding the surgical and procedural risks involved. On the day of delivery, the patient was taken to the angiography suite where under fluoroscopic guidance; catheterization of the common femoral artery was performed. A bilateral contralateral approach was used to guide placement of 5F occlusive balloon catheters sized 8 by 20 mm into the internal iliac arteries and their anterior divisions. Once proper confirmation of placement was made by fluoroscopy, the catheters were secured and the patient was subsequently shifted to the operation theater for cesarean delivery. The balloon catheters were inflated with nonionic omnipaque medium (amount varying from case to case) after infant delivery. Hysterectomy was then performed followed by deflation of balloons before abdominal closure, to ensure homeostasis. However, catheter removal was done immediately after surgery but the vascular sheath was removed an hour later. The average duration of fluoroscopy exposure ranged from 120 to 160 seconds in our study group.

The cases of adherent placenta that had hysterectomy with internal iliac artery occlusion balloon placement formed our study group. The adherent placenta cases that underwent hysterectomy without interventional radiological procedure formed our comparison, control group. The study and control groups were compared in terms of intraoperative blood loss, which was the estimated blood loss as recorded by the anesthetist and the total number of blood products transfused (packed red

blood cells, fresh frozen plasma, cryoprecipitate, single donor platelets and random donor platelets). We also studied the mean operative time (excluding the time taken for occlusion balloon placement), length of postoperative hospital stay in days, use of adjuvant procedures, adjacent organ damage, cardiac arrest and maternal mortality.

Mean operative time was the total time taken from the start of surgery (abdominal incision) to the completion of cesarean hysterectomy but in cases who had interval hysterectomy, it was taken as the total time required for hysterectomy alone. Adjuvant procedures to contain intraoperative blood loss included uterine compression sutures, arterial ligation, abdominal packing, usage of recombinant factor VIIa and uterine artery embolization.

Data was entered into a Microsoft Excel worksheet and analyzed using STATA version 9.0 (College Station, Texas, USA) software. We used a one way analysis of variance (ANOVA) to compare the means of continuous variables and the Fisher's exact test to compare categorical variables. p -value < 0.05 was considered statistically significant.

RESULTS

A total of 32,354 deliveries were conducted at Fernandez Hospital in the period from 2001 to 2009. Adherent placenta was diagnosed in 41 cases, the incidence being one in 789 deliveries. Hysterectomy was performed in 27 (65.85%) of these 41 cases of adherent placenta. Preoperative internal iliac artery balloons were placed in six cases (study group); the remaining 21 cases of hysterectomy without internal iliac artery balloons were considered as the control group. Baseline characteristics of the two groups were not significantly different (Table 1).

25 (92.59%) of the 27 women had a cesarean hysterectomy while the remaining two women had an interval hysterectomy. A diagnosis of placenta accreta was made for five (18.52%) women, placenta increta for 12 (44.44%) women and placenta percreta for 10 (37.04%) women. Mean blood loss and need for transfusion of blood products was significantly less in the group that had preoperative placement of internal iliac artery balloon catheters (Table 2). Other adverse operative outcomes were more frequent in the group without internal iliac artery balloons although these were not statistically significant (See Table 2). Fortunately, there was no maternal death in our entire series of cases or controls.

DISCUSSION

Adherent placenta is associated with life-threatening hemorrhage despite accurate preoperative imaging diagnosis and advanced surgical preparations. Hence, timely referral to a tertiary center and a multidisciplinary approach is ideal.

In this retrospective cohort study, we compared subjects who had pre-hysterectomy intravascular balloon catheter placement (study group) with those who had hysterectomy alone (control group), with a special focus on estimated blood loss and transfusion requirements.

Table 1: Baseline characteristics of the two groups

Characteristic	Hysterectomy with pre-op IIA balloons (n = 6)	Hysterectomy without pre-op IIA balloons (n = 21)	Statistical Significance
Mean age (years)	30.67 (4.72)	29.43 (4.11)	ANOVA F = 0.40, (p = 0.53)
Nulliparous	1 (16.67%)	1 (4.76%)	Fisher's exact test (p = 0.14)
Previous LSCS	5 (83.30%)	19 (90.48%)	Fisher's exact test (p = 0.55)
Previous miscarriage	4 (66.67%)	7 (33.33%)	Fisher's exact test (p = 0.19)
Placenta previa	6 (100.00%)	19 (90.48%)	Fisher's exact test (p = 1.00)
Antepartum hemorrhage	3 (50.00%)	8 (38.10%)	Fisher's exact test (p = 0.66)
Mean gestational age at delivery (weeks)	33.5 (3.21)	33.48 (5.72)	ANOVA F = 0.00 (p = 0.99)

ANOVA = Analysis of variance; Data presented as mean (Standard Deviation) or n (%)

Table 2: Operative and postoperative characteristics of the two groups

Characteristic	Hysterectomy with pre-op IIA balloons (n = 6)	Hysterectomy without pre-op IIA balloons (n = 21)	Statistical Significance
Mean operative time (minutes)	151.67 (49.46)	163.62 (76.64)	ANOVA F = 0.13 p = 0.72
Mean blood loss (ml)	1116.67 (204.12)	3823.81 (1912.04)	ANOVA F=11.66 p = 0.002*
Mean units of blood and blood products	0 (0.00)	17.14 (18.96)	ANOVA F = 4.77 p = 0.04*
Compression sutures	0 (0.00%)	1 (4.76%)	Fisher's exact test p = 1.00
Arterial ligation	1 (16.67%)	2 (9.52%)	Fisher's exact test p = 0.55
Abdominal packing	0 (0.00%)	1 (4.76%)	Fisher's exact test p = 1.00
Recombinant factor VIIa	0 (0.00%)	2 (9.52%)	Fisher's exact test p = 1.00
Uterine artery embolization	0 (0.00%)	1 (4.76%)	Fisher's exact test p = 1.00
Intraoperative adjacent organ injury	0 (0.00%)	4 (19.05%)	Fisher's exact test p = 0.55
Cardiac arrest	0 (0.00%)	2 (9.52%)	Fisher's exact test p = 1.00
Mean hospital stay (days)	12.17 (3.97)	11 (3.30)	ANOVA F = 0.53 P = 0.47

ANOVA = Analysis of variance; Data presented as mean (Standard Deviation) or n (%); *indicates statistically significant values

The significantly reduced blood loss in study group may be due to occlusion balloon mediated reduced uterine perfusion, allowing for a more controlled hysterectomy with reduced hemorrhage and surgical complications. Despite pelvic vascular anastomoses around these catheters, the presence of inflated balloons convert arterial bed pressures to venous circulation pressures, thus making the circulatory branches more amenable to hemostasis via simple clot formation. Other factor contributing to this finding is the greater proportion of elective hysterectomies in the catheter group. Briery et al⁸ stated that women undergoing an emergency cesarean hysterectomy are

more likely to have higher estimated blood loss and blood transfusions when compared to planned cesarean hysterectomy group.

Greater transfusion requirements in the no intervention group could have been due to greater hemorrhage and associated coagulopathy in these women. In fact, all cases of disseminated intravascular coagulopathy in our cohort belonged to this group.

Irrespective of preoperative usage of occlusion balloon catheters, Shrivastava et al⁹ and Bodner et al¹⁰ in their studies found no difference in terms of estimated blood loss, transfusion of blood products, operative time and duration of hospital stay.

However, our study demonstrated significant reduction in intraoperative blood loss and transfusion requirements with pre-hysterectomy balloon catheter placement, though the mean operative time and postoperative hospital stay were not significantly different across the two groups. Our findings were similar to those of Tan et al¹¹ except that in the latter, mean duration of cesarean hysterectomy was significantly less in the study group.

The main limitation of our study is its retrospective design and the comparison with historical controls as this intervention was used from 2008 onwards. Moreover, we found that this intervention has its own morbidity. In the six subjects who had prophylactic balloon catheter placement, one woman developed left femoral thrombus as a direct complication of catheterization, requiring thrombectomy. She remained hospitalized for 11 days but had a smooth clinical recovery.

To summarize, women with adherent placenta are at risk of massive blood loss and internal iliac artery occlusion balloon catheters by minimizing blood loss and transfusion requirements have a promising prospect as a morbidity reducing measure and life saving intervention.

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