Prophylactic preoperative balloon occlusion of hypogastric arteries in abnormal placentation: 5 years experience

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Aims and objectives

The purpose is to describe and evaluate the technique of prophylactic balloon occlusion of the anterior division of the internal iliac arteries (hypogastric arteries) in abnormal placentation.
A review of the computerized data base records of 32 patients with a diagnosis of placenta previa/accreta/percreta were done over a period of 5 years. These patients underwent prophylactic temporary balloon occlusion, followed by cesarean section.

During the same period of time a control group of 12 patients underwent cesarean section without endovascular intervention.

After admission of patients & because of high probability of major intra-partum hemorrhage & the potential for caesarean hysterectomy, high risk consents were obtained for that, & for other modalities of treatment, whether medical, surgical or both.

Particular attention was taken to ensure minimal fetal radiation exposure, by the use of appropriate shielding & intermittent low dose fluoroscopy. Total fluoroscopy time ranged from 0.5-3.14 minutes.

**Procedure;**

Seldinger technique was used to introduce the catheter into the vascular system, by making bilateral punctures of femoral arteries, followed by internal iliac artery catheterization via contra-lateral approach.

- The technique involved bilateral femoral arterial punctures and insertion of 6-French vascular sheaths under local anesthesia.

- Over a 0.035-inch angled guidewire (Flow Directed Balloon Catheter, Cook), a 5-French cobra-shaped catheter (Cobra, Terumo) was used to cannulate the contralateral internal iliac artery.

  - This was exchanged for a 5.5-French occlusion balloon catheter (Starterwire, Boston Scientific), which was positioned with its tip in the proximal portion of the contralateral internal iliac artery, just after the common iliac artery bifurcation.

- Once both balloon catheters were correctly positioned, a test volume of dilute water-soluble contrast material was injected to inflate the occlusion balloons to the optimal size.

- Once positioning was satisfactory, the catheters were securely taped to the skin.

- The occlusion balloons were inflated at the time immediately after the baby was delivered, and the umbilical cord was clamped so as to minimize the risk of fetal ischemia.

- In those who underwent hysterectomy or had the placentas delivered, the balloons were deflated just before skin closure after ensuring that hemostasis within the pelvic cavity was secured.
- In those in whom the placentas were retained, the balloons were left inflated until embolization was performed.

- The vascular sheaths were left in situ for 24 hours after surgery, with a view for emergency embolization in the event of severe postpartum hemorrhage.

- Slow continuous normal saline infusion (10 mL/h) through the sheaths was used to maintain patency of the sheaths without the use of heparin or anticoagulants.

- After removal of the sheaths, firm manual compression over the insertion site was performed for at least 20 minutes in all cases. No closure devices were used.
Results

The study compares two nonrandomized groups of patients.

In the balloon-occlusion group, the ages ranged 27-42 years with an average of 33.8 years & an average parity of 2.

The patients in the same group had previous 1-4 cesarean sections. Only 6 patients had no previous cesarean deliveries. Twenty two of thirty two patients had preexisting medical problems mainly diabetes mellitus, hypertension & protein S, gestational diabetes & epilepsy & low vitamin B12 level.

The outcome of pregnancy in the Balloon-occlusion group was 15 boys & 17 girls, with an average weight of 2.74 Kg & an APGAR score of 7 at one minute & score of 9 at 5 minutes.

In the control group the patients had previous 1-3 cesarean sections and 4 patients had no previous cesarean sections.

The outcome of pregnancy in this group was 4 boys and 8 girls with an average weight of 2.46 kg and an APGAR score of 5 at one minute and 9 at 5 minutes.

On the basis of gray-scale (figure 1) and color Doppler ultrasound examinations performed in the second or third trimester, placenta previa was detected in all 44 patients and, therefore, all patients were scheduled for cesarean section and possible hysterectomy. Gray-scale and color Doppler ultrasound suggested the presence of placenta accreta/percreta in 28 of 32 patients in the group treated with balloon-occlusion of hypogastric arteries, and suggested the presence of placenta accreta/percreta in 5 of 12 patients in the group treated without balloon-occlusion of hypogastric arteries.

MRI study (Figure 2, 3 and 4) was done only in 5 patients out of 32 patients of first group while done in 2 patients of control group.

At the time of delivery, placenta accreta/percreta was identified in all 28 patients that diagnosed with US and also in another 2 from the remaining 4 patients that were normal in US study. With histo-pathological assessment, the 2 cases were focal accreta.

All 7 out of 12 patients in control group placenta accreta/percreta was identified at the time of delivery. The remaining 5 patients were normal in US and at delivery.

Regarding the clinical data of both groups, the length of patient hospital stay ranged from 6-52 days in the balloon-occlusion group, with an average of 21.9 days. This length of stay, because once the patients were diagnosed as low lying placentae after 32 weeks of
gestation, they were kept in hospital to avoid catastrophic antepartum hemorrhage with inability to assess the hospital in time, since most of them lived in distant areas.

The postoperative stay period in the same group was 2-16 days, with an average of 7.1 days.

However, in the control group, the length of patient hospital stay ranged from 17-52 days with an average of 33.8 days.

The postoperative stay period in the same group was 4-19 days, with an average of 8.4 days this was more than our routine postoperative care, due to extra procedures undertaken with some patients including and treating complications, including wound infection, paralytic ileus, and intestinal obstruction.

In four patients, bladder injury occurred during operation and required surgical intensive care unit admission and occurred in 3 out of 12 patients of control.

Intraperatively extra measures utilized to control or minimize the amount of blood loss in both groups, in the form of medical measures like Hemabate was (prostaglandin F2#) injection, Cytotec (misoprostol) tablets inserted rectally intra and postoperatively, Factor VII injections & methotrexate post operatively; other measures were in the form of leaving part of or the entire placenta in situ if no signs of separation were noted.

Bakri balloon insertion, internal iliac artery ligation, bilateral tubal ligation and sub & total hysterectomy in only 4 patients were further means taken to save the life of the patient in the balloon occlusion group. Out of 12 patients of control group, 7 patients need sub and total hysterectomy, and 2 of them underwent bilateral uterine artery ligation.

The whole placentas or part of it were kept in four patients (3 patients from balloon occlusion group and one patient from the control group), two of them required methotrexate therapy to help in resolution of placental tissue.

The patients in the control group were delivered at an earlier gestational age than those in the balloon occlusion group (34.3 weeks vs. 35.6 weeks), and patients in the control group were hospitalized for a longer period of time than patients in the balloon-occlusion group (33.8 days vs. 21.9 days).

There amount of blood loss was more in control group than the balloon occlusion group (4.7 vs. 2.9 units).
Fig. 2: Sagittal T2W MR image of patient revealed complete placenta praevia centralis.

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**Fig. 3:** Coronal T2W images of same patient displaying complete placenta praevia centralis.

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Fig. 4: Complete placenta previa centralis. Mild irregularity and ill definition of the myometrium related to anterior aspect of the lower uterine segment that may represent placenta accreta

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Fig. 1: Gray scale ultrasonography showing anterior placenta previa completely covered the internal os (previa complete centralis). No clear space seen between the placenta and myometrium.

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Conclusion

Abnormal placentation (accreta, increta, and percreta) has emerged over uterine atony as the leading indication for peripartum hysterectomy (14).

Placenta accreta refers to a placenta that is abnormally adherent to the uterus, when the placenta invades the myometrium, the term placenta increta is used, whereas placenta percreta refers to a placenta that has invaded through the myometrium and serosa, sometimes into adjacent organs, such as the bladder. The term placenta accreta is often used interchangeably as a general term to describe all of these conditions (15).

Obstetric hemorrhage is the leading cause of the maternal mortality related to pregnancy (16). Cesarean hysterectomy is a definitive treatment for life-threatening postpartum bleeding of uterine origin that is unresponsive to medical or less invasive surgical treatments.

This reflects the increased proportion of obstetric patients with prior cesarean deliveries, a known risk factor for placenta accreta (17). Additional risk factors for abnormal placental implantation include advanced maternal age, multiparity, and repeated dilatation and curettage. The three variants of abnormal placentation that are associated with massive hemorrhage, which may lead to hypovolemic shock or a disseminated coagulopathy at delivery; this can cause considerable maternal morbidity and mortality. Therefore, antepartum recognition of invasive placentation is important for planning a multidisciplinary approach to a safe delivery and minimizing the risks of postpartum hemorrhage. Preoperative ultrasound with color Doppler imaging and MRI are used to establish the diagnosis of abnormal placentation and guide the clinical management, which can lead to more favorable outcomes (18).

Different treatment modalities are applied for peripartum hemorrhage in abnormal placental invasion. Uterine curettage, tamponade devices, peripartum hysterectomies, uterine artery ligation, hypogastric artery ligation, and hypogastric artery ballooning are the examples for the treatment. Hypogastric artery ballooning becomes very popular worldwide (19).

Recently, prophylactic hypogastric artery occlusion (Figures 4) was introduced to reduce intra-operative blood loss in patients at high risk for peripartum hemorrhage. Alvarez et al (13) reported the usefulness of prophylactic hypogastric artery occlusion without embolization in a small case-control study among patients at high risk for peripartum hemorrhage (20).

Occlusion of the hypogastric arteries does not eliminate the blood flow to the uterus because of the collateral vascular structures in the pelvis. However, the technique reduces the pulse pressure distal to the site of occlusion, thus minimizing blood loss during a hysterectomy (20).
This method helps to reduce blood inflow to hypogastric collaterals, both in the intra & post operative period, at a time when most blood loss occurs when the surgeon is trying to avoid hysterectomy, by using the different standard facilities available.

Antepartum recognition of invasive placentation is important for planning a multidisciplinary approach to a safe delivery and minimizing the risks of postpartum hemorrhage (21). Preoperative ultrasound with color Doppler imaging and MRI are used to establish the diagnosis of abnormal placentation and guide the clinical management, which can lead to more favorable outcomes (18).

The diagnosis of abnormal placentation is established by ultrasonography and occasionally supplemented by magnetic resonance imaging (MRI).

The sonographic features suggestive of placenta accreta include irregularly shaped placental lacunae (vascular spaces) within the placenta, thinning of the myometrium overlying the placenta, loss of the retroplacental "clear space," protrusion of the placenta into the bladder, increased vascularity of the uterine serosalbladder interface, and, on Doppler ultrasonography, turbulent blood flow through the lacunae (22).

Thinning of the uterine wall and loss of hypoechoic area between the placenta and myometrium were found by MRI in cases of placenta percreta.

Baughman et al. (23) described MRI characteristics of placenta accreta; placenta previa, uterine bulging, heterogeneous signal intensity within the placenta, dark intraplacenta bands on T2-weighted images, focal interruptions in myometrial wall, tenting of the bladder, direct visualization of the invasion of pelvic structures by placenta tissues. Sonography is the primary imaging modality for diagnosing accreta. However, when there is a posterior placenta accreta, ultrasonography may be less than adequate, and MRI may be superior to ultrasonography for this specific indication (22-24).

In our series, high suspicion of placenta accreta/percreta was documented sonographically in 28/32 cases (87.5%) in the group treated with balloon- occlusion of hypogastric arteries( figure 4), and suggested in only 7/12 cases (58.3 %) in the group treated without balloon- occlusion of hypogastric arteries.

This result is much less than the 100% suspicious of placenta previa in the Kidney et al series (20), which might reflect the difference in ultrasound experience between the two institutes. In spite of ultrasound expert diagnosis, yet there was an error rate of 40% after histopathology studies in the same study.

In our series, only in 15 cases (34%) histology specimen were sent to the laboratory, probably due to the fact that the placenta separated easily or because it was left in situ & sloughed off gradually in pieces.

The total fluoroscopy time ranged from 0.5-3.14 minutes, the average fetal radiation time which is the total fluoroscopy time, was much less, 1.5 min in our series in comparison
to 5.8 min. in the Kidney series (20) and 4.2 min. in Bonder et al study (11). This may be due to adoption of intermittent method of fluoroscopy in our institute.

According to the National Radiological Protection Board of the United Kingdom, the risk barely exceeds the threshold for diagnostic studies (25).

Intra-operative blood loss, the average blood loss in balloon-occlusion group was 1900 ml which is more in the control group; the average is 2800 ml which was statistically significant.

The amount of blood transfused was more in our series 2.9 in balloon occlusion group and 4.7 units in control group, in comparison to that of Kidney's who had an average of 1.8 units transfusion rate per patient. In the Kidney series hysterectomy was done in all patients.

Postoperative hospital stay was longer in our series average of 7.1 and 8.4 days in balloon occlusion group and control group respectively, vs 4 days in the Kidney series, probably because of the differences of the management.

In our series complication includes paralytic illus & intestinal obstruction (18%), the wound infection seen in about 10%, while the most serious complication, the bladder injury seen in 4 cases (12 %) in the balloon occlusion group. While in control group, paralytic illus & intestinal obstruction seen in 3/12 case (25%) and bladder injury seen in 3/12 cases (25%)

Cystotomy was reported in 40% of cases of Kidney series (bladder invasion by placenta) but did not occur in our studied patients.

In our study we found that the mean blood loss and transfusion requirements during hysterectomy were significantly decreased in patients who had the procedure, compared to those who did not. However, some other studies have shown conflicting results concerning the efficacy of prophylactic hypogastric artery ballooning; some have reported satisfactory outcomes for decreasing the mean blood loss and transfusion requirements (20-26), and others have reported no benefit (17-27).

We concludes that preoperative placement of internal iliac artery occlusion balloons is a safe and minimally invasive technique that reduces the intra-operative blood loss and transfusion requirements of patients with placenta accreta and its variants undergoing cesarean delivery.

This procedure is associated with a shorter duration of cesarean surgery, with no significant increase in the duration of ICU stay or hospitalization.

However, further studies are needed for more detailed outcome, side effects and to determine whether the potential benefits of prophylactic hypogastric artery occlusion
outweigh the potential risks associated with fetal radiation exposure and vascular complications. Team work & early collaboration is mandatory in these cases.
Fig. 5: Pre-operative fluoroscopy of same patient, shows the endovascular bilateral inflated internal iliac artery balloons.

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