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CASE REPORTS

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Prophylactic endovascular placement of internal iliac occlusion balloon catheters in parturients with placenta accreta: a retrospective case series

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ABSTRACT

Background: Endovascular occlusion balloon catheters can be placed preoperatively in internal iliac vessels of patients perceived to be at risk of major obstetric haemorrhage during caesarean section. Their safety and efficacy remains undefined, and we report our experience of 14 patients over four years.

Methods: We undertook a chart review of all patients who had undergone prophylactic internal iliac balloon catheters before caesarean section in our institution.

Results: Balloon catheters were placed in 14 and inflated in 11 (78.6%) patients. Five of the 14 patients (35.7%) underwent emergency balloon catheter placement before unscheduled caesarean section. Surgeons reported that balloon inflation provided favourable surgical conditions in six of 11 cases (54.5%), no improvement in four and was not required in one due to lack of pathology. Within the balloon-inflated group, nine patients underwent a hysterectomy: two electively, the remaining seven because of perioperative confirmation of placenta accreta or for control of bleeding. One patient suffered massive haemorrhage leading to three perioperative hypovolaemic cardiac arrests. Four patients required intervention to avoid complications related to balloon catheters: three minor and one related to catheter displacement and prolonged resuscitation.

Conclusion: Internal iliac balloon catheters can be inserted electively or in an emergency in patients at risk of major obstetric haemorrhage. Although useful in some, they are not universally effective; patients are still at risk of significant blood loss and at high risk of requiring a hysterectomy. In our experience, catheters can be placed electively or in an emergency but have been associated with adverse outcomes. These lessons have been important learning points in perioperative management.

Keywords: Interventional radiology; Endovascular occlusion balloon catheterisation; Internal iliac balloon catheters; Placenta praevia; Placenta accreta; Obstetric haemorrhage

Introduction

Perioperative embolisation by interventional radiologists may play a role in the management of major obstetric haemorrhage.[1,2] Prophylactic use of temporary internal iliac occlusion balloon catheters (IIOBC) has been reported previously for the management of massive obstetric haemorrhage, as an adjunct to hysterectomy and for minimising blood loss and associated massive transfusion.[3–9] There is much heterogeneity in published reports, with differing methodologies and definitions of successful outcome. Some studies advocate the potential benefits of prophylactic IIOBC placement,[8–11] while others have reported no beneficial effect on major outcomes.[12–14]

Placenta accreta is an increasingly common cause of major obstetric haemorrhage and caesarean hysterectomy, with apparent increase in frequency attributed for the most part on the rising caesarean section (CS) rate.[15–21] We report our institutional experience with prophylactically-placed bilateral IIOBCs in patients with placenta accreta over a four-year period.

Methods

Approval for this study was granted by the New Zealand Health and Disability Ethics Committees. We are a tertiary obstetric care and national referral centre with over 7500 deliveries per year and a CS rate of approximately 30%. Our labour epidural rate is 60% and 8% of CS are performed under general anaesthesia.

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Table 1 Case series

Case	Parity	Gestation (weeks)	Previous CS	Surgical procedure	Anaesthesia	Balloons inflated	EBL (mL)	Blood transfusion	ICU	Remarks
1	G2P1	38	1	El CS + tubal ligation	GA	No	700		No	Anterior placenta extending to lower segment
2	G5P3	38	2	El CS + hysterectomy	GA	Yes	6000	7 units RBC 5 units platelets 4 units FFP, 300 ml cryoppt	Yes	Complete praevia; placenta separated easily but uncontrolled bleeding leading to hysterectomy; bleeding throughout despite IIOBC inflation. Postoperative ICU for pulmonary oedema and possible transfusion related acute lung injury
3	G3P2	34	2	Emg CS + hysterectomy	GA	Yes	3000	4 units RBC	Yes	Recurrent APH + preoperative blood transfusion; features suggestive of placenta accreta on ultrasound; Emg CS for heavy bleeding + early labour; Praevia only; unable to secure haemostasis requiring hysterectomy. IIOBC inflated with good haemostasis for procedure
4	G5P4	37+5	3	El CS + hysterectomy	GA	Yes	5000–6000	7 units RBC	Yes	Multiple episodes of APH; continuing bleeding from lower uterine segment despite IIOBC inflation; hysterectomy required
5	G5P1	32	1	Emg CS	GA	No	1500		No	Triplets; APH, mild gestational proteinuric hypertension; placental abruption; posterior placenta praevia
6	G2P0	38	0	El CS	GA	No	900		No	Large anterior fibroid; anterior placenta praevia with no evidence of accreta
7	G3P2	34	2	El CS + hysterectomy	GA	Yes	1000		No	Small APH; placenta percreta on entering pelvic cavity; decision to hysterectomy immediately after baby delivered; IIOBC inflated and found helpful by surgeons
8	G3P2	33	2	Emg CS + tubal ligation	GA	Yes	700		No	No evidence of accreta/percreta; placenta separated spontaneously and easily; IIOBC inflated but not required.
9	G7P6	35	5	Emg CS + hysterectomy	CSE converted to GA intraop	Yes	15 000	21 units RBC 16 units whole blood 6 units platelets 16 units FFP 9 units cryoppt 12 mg rF VIIa	Yes	BMI 64; massive haemorrhage from uterine tear following vaginal instrumental delivery; 3 perioperative cardiac arrests; IIOBC inflated but possibly displaced; continued bleeding despite hysterectomy; postoperative embolisation in radiology after resuscitation and stabilisation. Remaining undisplaced catheter used for embolisation
10	G4P3	37	2	Emg CS + hysterectomy	GA	Yes	4000–5000	9 units RBC	No	CS for APH; placenta grossly adherent, proceeding to immediate hysterectomy; IIOBC inflated with good haemostasis intraoperatively, IIOBC deflated and removed at end of case; complicated by postop bleeding requiring laparatomy with estimated 2500 mL blood in pelvis)
11	G6P5	27	5	Emg CS Hysterectomy 3 weeks postpartum	GA	Yes	6000–7000	6 units RBC 4 units FFP 477 ml salvaged blood	No	Previous emg CS with scar dehiscence 1 year previously Emergency CS for pre-term labour; placenta left in situ after delivery with minimal blood loss (700 mL), post caesarean delivery embolisation; preoperative IIOBC placed for hysterectomy; significant blood loss; haemostasis only achieved with over-sewing of cervix and placental remnants; inflated IIOBC felt helpful
12	G3P1	35+5	1	El CS	GA	Yes	2500–3000	4 units RBC	No	2 episodes APH requiring admission; major placenta praevia, no accreta; bleeding placental bed requiring modified B-Lynch suture for haemostasis; IIOBC inflated but did not improve surgical conditions
13	G5P2	38	2	El CS + hysterectomy	GA	Yes	4500	3 units RBC 1 unit FFP 1 unit platelets 250 ml salvaged blood	No	Morbidly adherent major placenta praevia left in situ, hysterectomy performed. IIOBC inflation helpful for surgeons
14	G2P1	38	1	El CS + hysterectomy	GA	Yes	1500		No	Placenta adherent to anterior uterine wall with evidence of increta; IIOBC inflated as cord clamped; hysterectomy after delivery. Effective haemostasis throughout

El CS, elective caesarean section; Emg CS, emergency caesarean section; GA, general anaesthesia; IIOBC, internal iliac occlusion balloon catheters; APH, antepartum haemorrhage; CSE, combined spinal-epidural; EBL, estimated blood loss; ICU, intensive care unit; RBC, red blood cells; FFP, fresh frozen plasma; cryoppt, cryoprecipitate; rFVIIa, recombinant FVIIa; BMI, body mass index.

We identified all women who had undergone prophylactic IIOBC placement before CS from Auckland City Hospital's Radiology Information System (RIS) using specific radiology coded keywords "iliac angioplasty bilateral" and "embolisation without coils" from the period spanning May 2006 to August 2009. Relevant data were gathered by review of each patient's chart. Key outcome data were: surgical conditions noted in the chart, total estimated blood loss, the need for hysterectomy and any complications associated with IIOBC insertion. All operating surgeons completed a retrospective questionnaire on the use of the IIOBC and its efficacy for controlling blood loss. This was followed-up with a confirmatory interview to clarify or elaborate on surgical and intraoperative haemostasis.

Results

Table 1 summarises the case series. The mean age was 34.2 years (range 23–40 years), with a mean gestational age of 34.5 weeks. The median gravidity was 4.5 and the median number of previous CS was 2 (range 0–5). All IIOBCs were inserted before surgery. Eight were for scheduled elective CS, five were inserted in an emergency and one was placed before a planned hysterectomy for placenta percreta three weeks after CS. Of the emergent group, three were placed in early labour, one for an abruption and one for ongoing antepartum haemorrhage (APH).

All cases except one (case 9) were performed under general anaesthesia. Women were premedicated with 150 mg oral ranitidine and 30 mL 0.3 M sodium citrate. The IIOBCs were placed under fluoroscopic guidance and conscious sedation in the interventional radiology suite and then transferred to the operating theatre for CS. The position of the IIOBC was rechecked in the operating theatre using portable fluoroscopy, either before or just after induction of anaesthesia and, if inflation was required, the IIOBCs were guided by the interventional radiologist. All women had at least two large bore intravenous cannulae and invasive blood pressure monitoring. After a rapid sequence induction, the airway was secured and volatile anaesthesia commenced. The cell saver was used in latter cases.

Table 2 summarises the major maternal outcomes. The balloons were inflated if surgeons had a confirmed diagnosis of placenta accreta or were struggling to achieve haemostasis. In six of the 11 cases, the operating surgeon found the use of the inflated IIOBCs efficacious for improving the surgical field and haemostasis. One out of these six patients had a postpartum haemorrhage (PPH) and returned to the operating theatre for a laparatomy (case 10). The inflated IIOBCs did not improve surgical conditions or decrease blood loss in four cases and was thought unnecessary in one because of lack of pathology. In one of the four (case 9), the IIOBCs were displaced and were thought to have increased blood loss. Nine of the 11 women who had the IIOBCs inflated had a caesarean hysterectomy. Hysterectomy was planned preoperatively for confirmed placenta percreta in two of the nine. Of the planned procedures, one was diagnosed on ultrasound preoperatively, and the second hysterectomy was delayed for three weeks after percreta was confirmed during CS (case 11). The remaining seven cases were intraoperative surgical decisions: three on-table confirmations of morbidly adherent placenta and four for haemorrhage control.

The mean estimated blood loss for the inflated IIOBC group was 4632 mL (range 700–15 000) and eight of the 11 women required blood transfusion, seven of whom had a hysterectomy. Of the women who required blood transfusion, four were admitted to ICU postoperatively. All women who had IIOBCs sited, inflated or not, were transferred to a maternal high-dependency unit postoperatively for monitoring according to our institutional protocol. Two women of the nine who underwent a hysterectomy did not require blood products perioperatively (cases 7 and 14). There were no mortalities.

We identified complications and near misses in our case series (Table 3) which ranged from minor events (groin haematoma) to near misses (air in pressurized lines, symptomatic hypotension) and potentially catastrophic events (transient leg ischaemia and catheter migration). The use of a regional technique in case 9 was hampered by prior placement of the IIOBCs, as subsequent positioning for regional anaesthesia was thought to have led to their perioperative migration. This case was complex because of the woman's high body mass index (64 kg/m^2), five previous caesarean sections and major placenta praevia. She continued to haemorrhage despite a hysterectomy and suffered three perioperative hypovolaemic cardiac arrests. Her surgical care involved both vascular and urology subspecialties as well as massive blood transfusion and transfer to radiology for postoperative embolisation. Her stay in

Table 2 Maternal outcomes and surgical assessment associated with balloon intervention

	Inflated ($n = 11$)	Not Inflated ($n = 3$)
Mean EBL (mL)	4632 [700–15 000]	1033 [700–1500]
Blood transfusion	8	0
ICU admission	4	0
Hysterectomy	9	0
Surgical assessment		
Favourable	6	
Unnecessary	1	
Ineffective	4	

Data are mean [range] or number.
EBL, estimated blood loss.

Table 3 Adverse outcomes and management

Case	Complication	Management
1	Left groin haematoma	Oral analgesia
2	Large volumes of air in tubing to femoral sheath with potential for air embolism if bags re-pressurized noted after patient transferred to ICU	Lines changed and re-primed
4	Symptomatic hypotension during insertion of endovascular balloons; no attributed cause from clinical notes	Intravenous fluid
9	Migration of catheters from internal iliac arteries perioperatively, possibly hindering surgical management and contributing to haemorrhage and hypovolaemic cardiac arrest	Massive blood transfusion; involvement of vascular and urology surgeons; postoperative embolisation once stabilised
9	Mottled leg, sluggish capillary refill after transfer back to ICU post-embolisation	Removal of femoral sheath with immediate resumption of normal colour and perfusion

hospital was prolonged due to hypoxic encephalopathy, from which she made a full recovery after rehabilitation.

The correlation between ultrasound findings and final diagnosis is presented in Table 4. The final diagnosis concurred with imaging in 10 of 14 cases. The cases are in chronological order and show three false positives (cases 1–3) and one false negative (case 9).

Discussion

The aim of temporary bilateral occlusion of a proximal artery is to reduce the pulse pressure distal to the site of occlusion, slowing the rate of blood flow, thus improving the surgical field and decreasing blood loss until haemostasis or definitive surgery can be achieved. Diversity in technique and outcome measures within the current literature makes consensus interpretation difficult. Published case studies have reported success in decreasing blood loss and transfusion requirements as well as preservation of fertility.[3–9] In our series a number of women in whom the IIOBCs were inflated progressed to a hysterectomy. More than half of the 11 women with IIOBCs inflated had a blood transfusion. Our outcomes and EBL is in keeping with previously published literature.[10–14] The EBL in the group where the IIOBCs were not inflated may reflect the lesser severity of disease although statistical comparison between the two groups was not valid due to the small non-randomised samples. The IIOBCs have been inflated with mixed satisfaction amongst our surgeons.

Table 4 Correlation between imaging and final diagnosis

Case	Imaging	Surgical/histopathological diagnosis
1	US: low lying anterior placenta MRI: suggestion of diffuse placenta accreta with some suggestion of focal percreta	Anterior placenta extending into lower segment, no accreta
2	US: anterior placenta praevia and accreta	Major placenta praevia
3	US: major placenta praevia with features of accreta	Major anterior placenta praevia
4	US: major anterior praevia, cannot exclude accreta	Placenta praevia and partial accreta
5	US: posterior placenta praevia, triplet gestation	Placenta praevia
6	US: major anterior placenta praevia	Anterior placenta praevia, no accreta
7	US: low anterior praevia, suspicious for accreta	Placenta percreta
8	US: major placenta praevia	Placenta praevia with multiple blood vessels overlying uterus and bladder. No evidence of accreta
9	US: major placenta praevia	Focal placenta accreta
10	US: minor anterior praevia with high probability of accreta/increta	Placenta praevia and increta
11	US and MRI showing percreta	Placenta percreta
12	US: low anterior placenta covering internal os. No evidence of accreta	Major placenta praevia, no evidence of accreta
13	US: anterior placenta praevia with evidence of accreta	Morbidly adherent placenta praevia – accreta histologically
14	US: major praevia with suggestion of accreta MRI suggests no bladder involvement	Placenta increta

US, ultrasound; MRI, magnetic resonance imaging.

Ultrasound (US) imaging is needed for women with a history of previous CS in their third trimester to determine placental position.[22] Selection for IIOBC intervention in our patients depended on the attending obstetrician. They used a diagnosis based on US findings suspicious of accreta, or patients deemed at high clinical risk of placenta accreta (anterior placenta praevia on US with a history of previous CS). Characteristic findings on US are irregular shaped placenta lacunae (vascular spaces), thinning of myometrium overlying the placenta and loss of retroplacental 'clear space', with increase vascularity.[15] Specialist US with colour Doppler has a sensitivity of 0.77 and a specificity of 0.96 compared with MRI which has a sensitivity of 0.88 and specificity of 1.0.[23] In our case series, the final diagnosis correlated with US imaging in 10 out of 14 cases; there were three false positives and one false negative. Case 4 was managed as per confirmed placenta accreta (on a history of previous CS, anterior placenta praevia and antepartum bleeding) despite US findings which could not exclude accreta. However, it is our false negative results (case 9) that are of greatest concern as the management of placenta accreta should ideally be planned for and contingencies put into place. Bodner et al.[12] reported a significant number of unsuspected cases of placenta accreta (18 of 22 patients). This would imply that clinical risk factors alone should lead to a pre-delivery suspicion of placenta accreta. Clinical suspicion, however, is an unreliable predictor of histological findings, correctly identifying only 48% of cases.[19] Women at risk of, or having confirmed US findings of placenta accreta, should be counselled and plans put in place to deliver at a tertiary obstetrics unit with vascular and interventional radiology services in both emergent and elective scenarios.

In our institution, we found that IIOBC placement can be successfully undertaken at an emergent stage. Five of 14 women had the IIOBCs placed acutely: three in early labour, one for continuing APH and one in a triplet gestation with abruption but no fetal distress. It is unsafe to attempt IIOBC placement in the antenatal subgroup if there is haemodynamic instability. Studies have also recommended prophylactic IIOBC placement for potential use in perioperative embolisation,[8,10] as emergency placement in the setting of resuscitation and coagulopathy would be more difficult. In our case series, only one patient (case 9) had previously-positioned catheters utilised for postoperative embolisation. In another patient (case 10) who had a PPH, the catheters and sheath had already been removed in recovery before surgical re-exploration. Mok et al.[8] recommended delaying removal of IIOBCs for 12 h post-delivery as an appropriate timeframe to enable their use in cases of delayed or recurrent PPH. There is, however, a risk of arterial thrombosis associated with delayed removal.

Case 9 clearly demonstrates the risks of patient movement after IIOBC insertion. We suspect that displacement may have led to increased haemorrhage. The case was early in our institutional experience. The anaesthetic team felt that an extremely morbidly obese parturient was better managed with a regional technique.[24–27] In retrospect, this should have been instituted before IIOBC insertion and catheter position checked once the patient was positioned on the operating table. Both points are now part of our institutional guidelines. Recent publications have made a case for caesarean delivery in the radiology suite, where facilities are appropriate.[28,29] This would significantly reduce the risk of IIOBC displacement and also allow for immediate emergent embolisation if haemorrhage post-delivery was uncontrollable.

Other events relating either directly or indirectly to the IIOBCs were transient leg ischaemia from a femoral sheath left in-situ, and the potential for air embolus from air in the lines. One woman had symptomatic hypotension during the insertion in radiology. This may have been because of lack of lateral tilt, hypovolaemia or sedation. It can be argued that sedation is not required for the insertion of IIOBCs and some institutions place them under neuraxial blockade or local anaesthesia alone. Our radiologists have stopped using sedation since this issue has been highlighted in our findings. Other adverse outcomes were minor, easily-managed and had no long-term sequelae. Acute limb ischaemia is a rare but important complication.[13,30,31] Tan et al.[11] and Shrivastava et al.[13] also reported complications that included secondary PPH and significant ischemic limb events.

IIOBC placement may not be effective in stemming or slowing blood loss. The gravid uterus has an extensive collateral blood circulation,[17] which might not be effectively stemmed with just bilateral balloon occlusion of the internal iliac arteries. Bleeding can also occur from a poorly-contracted lower uterine segment or uterine atony from other causes, or from the cervix and vagina; other surgical methods should be attempted. The development of uterine atony and PPH can be delayed. The IIOBCs should be used alongside other surgical techniques like uterine artery ligation, vascular tapes, B-Lynch suture and balloon tamponade.

We noted that two women underwent hysterectomy with no blood transfusion requirements (cases 7 and 14). This may indicate efficacy of the inflated IIOBCs as well as the careful planning and the elective nature of the hysterectomy with early surgical decision to definitive management.

There are inherent problems associated with a retrospective review where data collected may be incomplete or unavailable. Our clinician survey relied on surgical documentation and recall of events, and some changes in practice may have occurred as the technique was refined. There are no current objective measures of 'surgi-

cal conditions'. The information was observational, retrospective and non-randomised. There was no equivalent case-control group with which to make direct outcome comparisons and our numbers were small. These factors have made statistical analysis and definitive cause and effect judgements between the intervention and outcomes inappropriate. The total number of cases of placenta accreta is still low compared to the number of total deliveries per year, despite the reported 10-fold increase in incidence in the last 50 years,[32] and the diagnosis can only be definitively confirmed either histopathologically or from surgical findings. This in itself makes conducting a randomised control trial difficult due to small numbers and future research should involve multiple centres.

In conclusion, IIOBCs may be a useful adjunct during CS or for access for postoperative embolisation but cannot be relied upon to improve surgical conditions or prevent blood transfusion or hysterectomy. They can be placed electively or in early labour in women who are haemodynamically stable. Careful patient selection is warranted as the IIOBCs are associated with potentially serious complications. Our study results do not support their routine use at this stage but our experience has enabled our institution to refine its protocols for management.

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Multiple complications following the use of prophylactic internal iliac artery balloon catheterisation in a patient with placenta percreta

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ABSTRACT
The incidence of placenta praevia/accreta is increasing, placing women at significant risk of postpartum haemorrhage with associated morbidity and mortality. National guidelines recommend prophylactic placement of internal iliac artery balloon occlusion catheters for women with abnormal placentation. We describe an elective caesarean delivery in a patient with placenta percreta who underwent this technique. She developed bilateral pseudoaneurysms, unilateral arterial rupture and compromised vascular supply to her right leg secondary to thrombus formation, and suffered massive haemorrhage, both despite and as a result of intervention. This is the first case report of multiple complications in an obstetric patient after temporary internal iliac balloon occlusion in an elective setting.

Keywords: Placenta accreta, percreta; Interventional radiology; Balloon catheters; Internal iliac artery; Complications

Introduction

Placenta percreta is characterised by placental villous invasion of the myometrium and attachment to adjacent organs.[1] If bladder invasion is present, maternal mortality is reported to be as high as 20% with a perinatal mortality of 30%.[2] National guidelines recommend the use of interventional radiology (IR) with prophylactic placement of internal iliac artery balloon occlusion catheters (IIABOCs) to reduce intraoperative bleeding during caesarean section for women with abnormal placentation.[3] We describe a case of a patient with placenta percreta who underwent an elective caesarean section and in whom this technique was used.

Case report

A 36-year-old parturient (G2P1) with a body mass index 21 kg/m^2 and a past history of emergency caesarean section (CS) under spinal anaesthesia for failed induction of labour, was scheduled for an elective CS at 37 weeks of gestation. The indication was placenta percreta with bladder invasion diagnosed on ultrasound scan at 35

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