

Title:

Kasr Alainy simplified conservative uterine surgery for abnormally invasive placenta (AIP): surgical technique.

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Short running title:

Simplified conservative surgery for abnormally invasive placenta

Keywords:

Placenta accreta- conservative- surgery- caesarian section- caesarian hysterectomy

Abstract:

The incidence of placenta accreta has risen significantly owing to global surge in caesarian section rates. It is associated with significant morbidities and mortality and is usually managed with caesarean hysterectomy (CsH). Uterine preserving conservative surgeries have advantages over CsH and leaving placenta in-situ techniques. We present a new conservative surgery technique that was applied on 20 patients with abnormally invasive placenta. It was successful in 90% of cases for preservation of the uterus. It was associated with relatively low blood loss and morbidity outcomes. Our simplified easy to learn technique can be useful especially for countries with limited resources.

Introduction:

Placenta accrete spectrum (PAS) has been proposed as a term that includes abnormally adherent placenta (ADP) (placenta accreta) and abnormally invasive placenta (AIP) (placenta increta, placenta percreta).¹

PAS refers to placentas that do not separate spontaneously after fetal delivery, or that cannot be removed without causing significant life-threatening haemorrhage.² PAS is responsible for 29% of post-partum hemorrhage (PPH) with caesarean hysterectomy (CsH)³ as well as significant neonatal and maternal morbidity and mortality. The later can reach up to 7% in some communities.⁴

The management modalities for PAS cases are there folds: (a) radical management with CsH, (b) expectant management with the “leaving the placenta in-situ” technique, and (c) conservative management with uterine preserving surgeries.²

Conservative surgery has the obvious advantage over radical management of preserving the uterus for future fertility, which provides significant psychosexual advantages for women in low and middle income countries (LMIC) and social background where fertility is highly cherished.^{5,6,7} Additionally, conservative surgery is associated with less long-term morbidities than expectant management.^{2,4,8,9,10,11}

The Royal College of Obstetricians and Gynecologists (RCOG) advocate management by a multidisciplinary team (MDT) with expertise in diagnosing invasive placentation and complex pelvic surgeries. That should be in a PAS specialist center with access to blood products, adult and neonatal intensive care units.¹² In LMIC countries, access to advanced preparations and services like intensive care, blood products and interventional radiology is limited.

In this article, we are clearly describing, with video and images, possibly the simplest technique of uterine preserving surgery published to date, which we applied on 20 patients with AIP and had promising results.

Methodology:

Subjects

This study was conducted between 8/2019 and 2/2020 at the University Department of Obstetrics& Gynecology in Kasr Alainy, a tertiary care teaching hospital of Cairo University that meets most criteria recommended by the international society of AIP for what constitutes a

specialist center for AIP, with the exception of intraoperative cell saver and the presence of an interventional radiologist among our MDT.²

After receiving extensive counseling and signing an informed consent, 20 women were enrolled in our study. Inclusion criteria included any patient with preoperative diagnosis of AIP that was then confirmed intraoperative and by postoperative histopathological examination. Exclusion criteria included ADP cases and women who preferred having CsH instead. Diagnosis was made by US performed by an imaging expert among our MDT, using 4-8 MHz trans-abdominal probe (voluson P8, GE, Zipf, Austria). US criteria most indicative of AIP were: loss of clear zone, abnormal lacunae, uterovesical and subplacental hyper-vascularity (Figure S1).¹³

Women were followed-up in outpatient clinic (OPC) with close fetal surveillance. Most were electively admitted at 35 weeks of gestational age (GA) and received 24 milligram of intramuscular dexamethasone (Epidron, Eipico, Egypt) in two divided doses.¹⁴ Most surgeries were at 36+ weeks of GA.² Demographic data and surgical outcomes were recorded.

Surgical technique (video S1)

One gram of diluted tranexamic acid (Kapron, Amoun, Cairo, Egypt) is given to all women 15 minutes preoperative.¹⁵ 20 French Foley balloon catheter is inserted into the urinary bladder (UB). We use general anesthesia.¹⁶

Following low midline skin incision, subcutaneous fat and rectus sheath are opened in layers, peritoneum is incised, rectus muscles are separated, and the gravid uterus with bulging placenta and adherent UB is exposed. (Figure 2)

Our technique main steps are summarized in table S1 and include:

1. Dissection of the UB from the anterior uterine wall by incising the vesicouterine peritoneal fold followed by vascular disconnection of the neoformed vessels connecting the AIP to the UB. This is done through cauterization or ligation of their uterine and vesical ends with 2-0 polygalactin (vicryl TM, Ethicon) sutures then cutting between them with dissecting scissors or cutting diathermy. Vesical traction with 2-3 Babcock forceps can be carried out to facilitate this procedure (figure S3.1). Dissection is carried out until ureters are reached out and identified bilaterally.
2. Transverse uterine incision just above the AIP upper border, followed by foetus delivery (figure S3.2). Uterus is then exteriorized without trial separating the AIP, and the incision edges are approximated with towel forceps to reduce blood loss.
3. AIP devascularisation through: A) Bilateral ligation of uterine arteries by polygalactin 1.0 all through sutures, above and medial to the pre-identified ureter (figure S3.3.1, figure S3.3.2) (tip: the suture knot may contain a part of an adjacent myometrium for reinforcement). B) Bilateral or unilateral all thorough suture ligation of UAs at a level 2 centimetres above the incision line (figure S3.3.3, figure S3.3.4) (tip: that knot may include adjacent myometrium segment for reinforcement and all broad ligament varicosities. It should also exclude fallopian tube, ovarian ligament and mesosalpingeal veins just below the tube. It should be done under vision, with the anterior leaflet of broad ligament open, to avoid any inadvertent injury to the ureter or the aforementioned structures. This is done only in cases with broad ligament invasion and accompanying extensive neoformed vessels that eventually feed the AIP). C) Anterior and posterior cervical wall vascular control sutures are taken. In some cases, further UB dissection

anteriorly is required before taking anterior suture below the AIP lower border. Posterior suture is placed at the level of uterosacral ligament (figure S3.3.5, figure S3.3.6, figure S3.3.7).

4. Resection of the invaded part of the myometrium with the AIP en bloc (tip: the incision at the upper border of the AIP should be continuous with the uterine incision done to deliver the foetus to avoid double incisions with more blood loss) (figure S3.4).
5. Transverse simple interrupted full- or partial thickness compression sutures are taken in the posterior or the remaining of anterior uterine wall if there is any residual bleeding from the placental bed. (figure S3.5)
6. Myometrial reconstruction in 2 layers by continuous polygalactin 1-0 sutures. (Figure S3.6). If UB injury is suspected (3 cases), methylene blue test is carried out, and UB is repaired by polygalactin 2-0 sutures if injured (one case).

Intra-peritoneal wash is then done with lactated ringer, haemostasis is ensured, ureters are re-checked, and two 24 French intraperitoneal drains are inserted into the retrovesical region. Regenerated cellulose (surgicell, Ethion) is sometimes inserted on the uterine scar line or the UB posterior wall for haemostasis. Parietal peritoneum is approximated with polygalactin 2-0 sutures and rectus sheath is approximated with two PDS loop size 0 proline sutures.

Intraoperative blood loss is estimated by counting the number of soaked towels, gauzes and amount of blood in suction device. Postoperative loss is estimated by the amount of blood in intraperitoneal drain and vaginal bleeding.

2 grams of cefazolin¹⁷ (Zinol, Pharco, Alexandria, Egypt) and 40 IU oxytocin¹⁸ (Syntocinon, Novartis, Basel, Switzerland) are given intraoperative. Postoperative, we give 800 microgram of misoprostol¹⁹ (misotac, Sigmapharm, Cairo, Egypt) and prophylactic doses of low molecular weight heparin (Clexan, Sanofi, Paris, France) 8 hours after surgery, and once daily until full mobilization.²⁰

All drains are removed on day one postoperatively except if draining ≥ 300 cubic centimeters of serosanguinous fluid (two cases), then it is evacuated and left for another day. All specimens, which include the deficient uterine wall with the invading AIP, are sent for histopathological confirmation (figure S4). Areas of severe AIP invasiveness, i.e. placenta percreta, are marked with knots for guiding the histological sampling by the pathologist to give an accurate diagnosis (figure S5).²¹

Follow-up:

All patients are followed-up over the first few days postoperative for signs of PPH, fever, ileus, urine retention and vesico-uterine fistula. Signs of wound infections and deep venous thrombosis are monitored over 1-2 weeks. At 6 weeks, our sonographer assesses uterine involution, CS scar niche, intrauterine and intra-abdominal adhesions. Cases are instructed to start follow-up very early in the next pregnancy for signs of placental pathology or malfunction, example: CS scar ectopic, recurrent PAS, and preeclampsia.

Results:

AIP was confirmed intraoperative and histopathological in all 20 women. Patients' demographic data and surgical outcomes are provided in table S2. Successful preservation of uterus was achieved in 18/20 women in with AIP (90%), while 2/20 (10%) women required CsH and

one had UB injury (5%). The latter two complications were intimately related to AIP deep cervical invasion. Flowchart of the participants is shown in figure S6. In table S3, we present a comparison of the outcomes of our series with those of other conservative surgery techniques.

In our series, one patient developed postoperative paralytic ileus that was managed conservatively.²² One patient had wound infection, managed with wound culture, antibiotics and repeated dressing.²³ One patient had significant uterine scar niche, more than 1 cubic centimeter by US,²⁴ which is causing her continuous spotting and is managed by norethisterone acetate.²⁵ One patient had peritoneal pseudocyst by US, which is essentially due to intraabdominal adhesions, and is causing her intermittent attacks of pelvic-abdominal pain that are managed with analgesics.^{26,27}

Discussion:

Several conservative surgery techniques were introduced into the current practice over the past few decades.^{2,4} However the surgical complexity in some of them and the need for advanced preparations in others have led to their limitation in clinical practice.^{5,7,8,9,10,28}

In our study, we aimed to clearly describe our simplified approach for conservative surgery for management, which can be relatively easily applied in LMIC. We present several images and video to illustrate the technique for reproducibility. We also present a comparison with other uterine preserving surgeries regarding the technique and outcomes.

Our technique is primarily based on placental bed devascularization followed by excision of the invaded segment of uterine wall with the invading AIP en bloc. Sparing the ovarian ligaments ensures avoiding uterine ischemia from significant devascularization. Similarly, preservation of fallopian tubes keeps the fertility capacity.

The simplicity and the major difference of our technique from other uterine preserving surgeries is essentially in the step of devascularization. While devascularization needs endoscopic arterial balloon occlusion in triple-P technique,^{5,28} involves aortic occlusion in one-step technique,^{7,8,9} and internal iliac artery ligation in stepwise technique,¹⁰ our technique involves only uterine artery ligation. Additionally, we don't leave placenta in-situ in cases of severe AIP invasion.^{5,28} We also don't reinforce posterior UB wall with sutures⁷ or use pulley sutures, fibrin glue, and reinforcement with polygalactin mesh to close the uterine incision.⁸

In our series, deep cervical invasion was associated with CsH in two cases. This is essentially due to absence of residual healthy myometrium, which we define as 2 centimeters or more, to constitute the lower edge for myometrial repair. In our experience, this is the minimum amount of residual healthy myometrium essential for efficient myometrial contraction to avoid primary atonic PPH. Only one patient with deep cervical invasion had successful conservative surgery, this patient had 2 centimeters of healthy muscular tissue remaining on the lower edge and few compression sutures eventually succeeded in controlling continuous bleeding from this tissue segment.

Deep cervical invasion was also associated with one UB injury; we believe this is due to the very narrow space on dissection between the AIP and UB at this depth downwards. This supports the recommendations of IS-AIP management guideline, which states that "attempting

local resection may be detrimental in cases involving invasion into the cervix and/or parametrium², and in line with the results of other conservative surgery.^{4,5,7,8,9,10}

In the Triple-P technique,²⁸ successful conservation and absent UB injury in all cases, as well as the less need for blood transfusion can be explained by the fact that only 54% of their cases were of severe AIP, i.e. placenta percreta, compared to 90% in our series. Additionally, in triple-P technique,^{5,28} AIP devascularization is done through endoscopic vascular occlusion by the interventional radiology service, and the placental portion invading the UB in severe AIP cases is usually left in-situ with close postoperative follow-up service. Even-though the latter two services may have improved their outcomes, we believe that they are not available in all LMIC.

The main limitation of our study is the relatively small sample size and absence of comparison group. Also, long term follow-up of cases and assessing their fertile capacity and the course of their future pregnancies was not feasible. However, we are currently conducting a study with a larger sample size and a control group, with long follow-up period to evaluate the safety and efficacy of our technique.

Conclusion:

In summary, our technique is associated with relatively less blood loss, hospital stay, and maternal complications when compared to other conservative surgical techniques. It does not need advanced preparations or involves difficult surgical skill. It should be considered for AIP cases, particularly in countries with limited resources.

Disclosure of interests

All authors confirm they have no disclosures specific to this study. For full up-to-date disclosure of Dr. Abdel- Fattah please see his university webpage

<https://www.abdn.ac.uk/iahs/research/obsgynae/profiles/m.abdelfattah>

Contribution to authorship

MA is the main surgeon, E MM is the experienced obstetrician and G HM is the imaging expert among our multidisciplinary team. E IT and MA wrote the manuscript. E IT and MA^{7th author} made the statistics. MA^{2nd author}, EM and MH edited, revised and critically analyzed the manuscript. E RO edited the figures

Details of ethics approval

At our institution, studies involving the modification of an existing surgical technique are exempted from formal Institutional Review Board approval. Before every procedure, written informed consent was obtained from each patient after the patients were informed of the potential benefits and risks.

Funding

Kasr Alainy OBGYN hospital is a Cairo University hospital that is covered by national insurance. The patients' bills, hospital equipment and physician wages are all covered by the local government.

Acknowledgement

We thank Dr. Ahmed Soliman for providing us with microscopic images and videos from the histopathology exam of the specimens containing the resected segment of uterine wall with the abnormally invasive placentas, example: figure 4

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Table S1: summary of the main steps of our simplified conservative surgery:

- 1- Vesicouterine fold dissection and separation of the invaded UB from the uterus with the AIP.
- 2- Uterine incision above the AIP borders and fetal delivery
- 3- Surgical devascularization by ligation of: A- uterine arteries at low level, B- uterine arteries at high level, which may include broad ligament varicosities, C- anterior and posterior cervical wall control sutures at the level of uterosacral ligaments.
- 4- Resection of the AIP with the invaded part of anterior uterine wall en bloc.
- 5- Simple transverse compression sutures to control any residual bleeding.
- 6- Myometrial reconstruction in 2 layers

Table S2: Demographic data and surgical outcomes of the participants

Demographic data (unit)		Median (IQR)
Age (years)		31 (6.5)
Parity (number)		2 (1)
Previous caesarian sections (number)		2 (1)
Gestational age at termination (weeks)		36 (0)
Surgical outcomes (unit)		Median (IQR)
Intraoperative blood loss (cubic centimeters (CC))		1400 (400)
Postoperative blood loss (CC)		100 (50)
Total blood loss (CC)		1500 (387.5)
Total blood transfusion (packed red blood cell units)		1.5 (2)
Hemoglobin drop (gram/ deciliter)		1.1 (0.65)
Operative time (minutes)		120 (37.5)
Hospital stay (days)		1 (0)
APGAR score minute 1		9 (1)
APGAR score minute 5		10 (1)
Surgical outcomes		Number (percentage)
Cervical invasion		3/ 20 (15%)
Failed conservative surgery (CsH)		2/ 20 (10%)
Urinary bladder injury		1/ 20 (5%)
Postoperative paralytic ileus		1/ 20 (5%)
Peritoneal inclusion cyst (pseudocyst) due to intra-abdominal adhesions		1/ 20 (5%)
Symptomatic uterine niche (>1 CC)		1/ 20 (5%)
Wound infection		1/20 (5%)
Blood transfusion needed		12/20 (60%)
Intraoperative blood loss > 1500 CC		3/20 (15%)
Neonatal intensive care unit (NICU) admission		6/20 (30%)
Ureteric injury		0
Maternal intensive care unit admission		0
Deep venous thrombosis		0
Severe intrauterine adhesions		0
Postoperative urinary retention		0
Vesico-uterine/ vaginal fistula		0
Arterial thrombosis		0
Postpartum hemorrhage		0
Postpartum fever (sepsis)		0
Maternal mortality		0
Serious morbidity: Renal failure requiring dialysis Respiratory failure Hysterectomy		0
Placenta previa type by ultrasound	Complete centralis	6/20 (30%)
	Incomplete centralis	14/20 (70%)

<i>Preoperative radiological diagnosis</i>	<i>Total percreta</i>	<i>5/20 (25%)</i>
	<i>Total increta, partial percreta</i>	<i>15/20 (75%)</i>
<i>Intraoperative clinical diagnosis</i>	<i>Total percreta</i>	<i>4/20 (20%)</i>
	<i>Total increta, partial percreta</i>	<i>14/20 (70%)</i>
	<i>Total accrete, partial increta</i>	<i>2/20 (10%)</i>
<i>Postoperative histopathological diagnosis</i>	<i>Placenta percreta</i>	<i>18/20 (90%)</i>
	<i>Placenta increta</i>	<i>2/20 (10%)</i>
<i>Past medical history</i>	<i>Free</i>	<i>14/20 (70%)</i>
	<i>Gestational Anemia</i>	<i>3/20 (15%)</i>
	<i>Gestational hypertension</i>	<i>1/20 (5%)</i>
	<i>Pregestational hypertension</i>	<i>1/20 (5%)</i>
	<i>Pregestational diabetes mellitus</i>	<i>1/20 (5%)</i>
<i>Termination time and setting</i>	<i>Elective (near 36 weeks)</i>	<i>18/20 (90%)</i>
	<i>Emergency (31 weeks)</i>	<i>1/20 (5%)</i>
	<i>Emergency (34 weeks)</i>	<i>1/20 (5%)</i>
<i>NICU admission</i>	<i>Re-admission for hyperbilirubinemia</i>	<i>3/20 (15%)</i>
	<i>Transient tachypnea of newborn</i>	<i>2/20 (10%)</i>
	<i>Prematurity</i>	<i>2/20 (10%)</i>

Table S3: comparison between our technique surgical outcomes and those available/ provided in other conservative surgery techniques (better outcomes are highlighted)

Surgical step	Our technique	One-step conservative surgery.^{7,8,9}	Triple-P technique.²⁸	Stepwise surgical approach.¹⁰
<i>Blood loss :</i>				
Median (range)				
Intraoperative	1400 (500-2000)			1700 (600-2400)
Postoperative	100 (80-350)			570 (400-1300)
Mean +/- SD				
-Intraoperative	1.3 +/- .36		1.70 +/- 0.95	
-total	1.4 +/- .36		2.31 +/- 1.38	
>1500 CC (%)	3/20 (15%)	94/326 (28.8%)		
<i>Blood transfusion:</i>				
Median (range)	1.5 (0-3)			4 (2-6)
-Number of patients requiring transfusion	12/ 20 (60%)		9/19 (47.4%)	
-Total RBCs units transfused	24		40	
Hb reduction	1.1 +/- 0.59		2.16 +/- 1.43	
PPH	0/20 (0%)		3/19 (15.8%)	
CsH required/ failed conservation	2/20 (10%)	96/326 (29.45%)	0 (0%)	6/71 (8.5%)
UB injury	1/20 (5%)	47/326 (14.4%)	0 (0%)	9/71 (12.7%)
Operative time Median (range)	120 (75-210)			85 (70-140)
Hospital stay	1.3 +/- 0.73		4.75 +/- 2	
Vesico-uterine fistula	0 (0%)		0 (0%)	1/71 (1.4%)
Paralytic ileus	1/20(5%)	13/326 (3.99%)		
Arterial thrombosis	0 (0%)	1/326 (0.3%)	1/19 (5.2%)	0 (0%)