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ORIGINAL RESEARCH ARTICLE

Uterine conservative–resective surgery for selected placenta accreta spectrum cases: Surgical–vascular control methods

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Abstract

Introduction: The incidence of placenta accreta spectrum (PAS) has increased, but the optimal management and the optimal way to achieve vascular control are still controversial. This study aims to compare maternal outcomes between different methods of vascular control in surgical PAS management.

Material and methods: A retrospective cohort study on consecutive cases diagnosed with PAS between 2013 and 2020 in single tertiary hospital. The final diagnosis of PAS was made following preoperative ultrasound and confirmation during surgery. Management of PAS using cesarean hysterectomy with internal iliac artery ligation (IIAL) was compared with two types of vascular control in uterine conservative–resective surgery (IIAL vs identification–ligation of the upper vesical, upper vaginal, and uterine arteries).

Results: Over an 8-year period, 234 pregnant women were diagnosed with PAS meeting the inclusion criteria. Uterine conservative–resective surgery (200 cases) was associated with lower mean blood loss compared with cesarean hysterectomy with IIAL (34 cases) in all PAS cases (1379 ± 769 mL vs 3168 ± 1916 mL; $p < 0.001$). In subanalysis of the two uterine conservative–resective surgery subgroups, the group with identification–ligation of the upper vesical, upper vaginal, and uterine arteries had a significantly lower blood loss compared with uterine conservative–resective surgery with IIAL (1307 ± 743 mL vs 1701 ± 813 mL; $p = 0.005$). Women in the hysterectomy with IIAL group had more massive transfusion (35.3% vs 2.5%; $p < 0.001$; odds ratio [OR] 21.3, 95% confidence interval [CI] 6.9–66), major blood loss (>1500 mL) (70.6% vs 34%, $p < 0.001$; OR 4.7; 95% CI 2.1–10.3), catastrophic blood loss (>2500 mL) (64.7% vs 12.5%;$p < 0.001$; OR 12.8, 95% CI 5.7–29.1), other complications (32% vs

Abbreviations: IIAL, internal iliac artery ligation; PAS, Placenta Accreta Spectrum.

12.4%; $p = 0.007$; OR 3.4, 95% CI 1.5–7.7), and intensive care unit admission (32.4% vs 1.5%; $p < 0.001$; OR 31.4, 95% CI 8.2–120.7) compared with the uterine conservative–resective surgery groups. The identification–ligation of the upper vesical, upper vaginal and uterine arteries had a significant lower risk for major blood loss (30.5% vs 50%; $p = 0.041$; OR 0.44, 95% CI = 0.2–0.9) compared with IIAL for vascular control of uterine conservative–resective surgery.

Conclusions: Cesarean hysterectomy is not the default treatment for PAS, PAS with invasion above the vesical trigone are suitable for uterine conservative–resective surgery with upper vesical, upper vaginal and uterine artery vascular control.

KEYWORDS
placenta accreta spectrum, uterine conservative–resective surgery, vascular control

1 | INTRODUCTION

Placenta accreta spectrum (PAS) disorders are rapidly becoming one of most common serious potentially life-threatening maternal perinatal problems. The incidence of PAS has increased significantly over the last decades and it is now estimated to occur in one in 533 deliveries;[1] this increase has followed the increase of cesarean scar pregnancy as the precursor of PAS from 1:2216 to 1:1800.[2] PAS may lead to massive intractable hemorrhage, disseminated intravascular coagulopathy, adult respiratory distress syndrome, massive blood transfusion, electrolyte imbalance, and renal failure.[3] The three main types of PAS management discussed in the literature include total hysterectomy, leaving the placenta in situ, and uterine conservative–resective surgery, but the optimal surgical management of PAS is still controversial.[4–6]

The American College of Obstetricians and Gynecologists recommends cesarean hysterectomy as the main management for PAS.[7] Cesarean hysterectomy is a life-saving procedure, associated with major risks for complications like injury to ureters, bladder, bowel, or neurovascular structures, and permanent loss of fertility with its associated psychological insult. PAS accounts for 38% of pregnant women requiring peripartum hysterectomy.[8] Maternal mortality may occur despite adequate planning, multidisciplinary management, and appropriate transfusion management.[9] Fertility preservation is desirable in many cases because of the relatively young age of the PAS pregnant women. The first described method to preserve the uterus was leaving the placenta in situ. This method requires the woman to stay in the vicinity of the hospital for several months of monitoring due to the high risk of sudden severe hemorrhage.[10] Some experts tried to develop several conservative–resective approaches in managing PAS for fertility preservation.[11] Palacios-Jaraquemada et al reported the first study about uterine conservative–resective surgery in 68 cases, 10 women had a subsequent pregnancy.[4] Palacio-Jaraquemada et al described that pregnant women with placental invasion above the bladder trigone are particularly suitable for uterine conservative–resective surgery.[4,12] Chandraharan et al reported a successful approach for avoiding peripartum hysterectomy in four women with PAS using the triple P procedure (Perioperative ultrasound—Pelvic de-vascularization using internal iliac artery balloon catheter—Placental non-separation with myometrial excision),[5] but this method is difficult to apply in many hospitals, particularly in many low-income countries.

Key message

Cesarean hysterectomy is not the default treatment for PAS. Internal iliac artery ligation is not the best option for vascular control in PAS management. Identification and ligation of the upper vesical, upper vaginal and uterine arteries are the key procedures reducing the blood loss during PAS management.

As part of the uterine conservative–resective surgical procedure, two methods of vascular control have been used: internal iliac artery ligation (IIAL) and the other focusing on vascular control of the vesical–vaginal–uterine arteries.

Dr. Soetomo Hospital in Surabaya is the main referral hospital for East Java (population about 38 million). Over the past decade we have witnessed a great increase in pregnant women presenting with PAS.

This has allowed us to build on the uterine conservative–resective surgical management initially championed by Palacios-Jaraquemada et al.[4] The aim of this large retrospective cohort study was to compare the maternal outcomes between two methods of vascular control used during the current uterine conservative–resective surgical approach of women presenting with PAS with the initial approach consisting of hysterectomy plus IIAL.

2 | MATERIAL AND METHODS

This is a retrospective cohort study, using medical, surgical, and pathological reports and ultrasound images on consecutive pregnant

women diagnosed with PAS from 2013 to 2020 in the main tertiary referral hospital in East Java. All women were followed for at least 6 month after surgery.

Inclusion criteria were based on the final preoperative diagnosis following preoperative ultrasound imaging consistent with PAS and on intraoperative confirmation during surgery.[13–15] All pregnant women were selected on the basis of specific preoperative ultrasound imaging and intraoperative staging[13,15–17] in our hospital, no woman had massive bleeding immediately before surgery, and all surgery was performed as an elective procedure in our hospital. Antepartum hemorrhage in PAS can occur and cause an emergency situation where preoperative diagnosis cannot be made. This situation is not included because the diagnosis was made intraoperatively with different preparation, such as aortic compression to reduce the blood loss during surgery and this can bias the maternal outcome.

Intraoperative diagnosis was based on guidelines published by Collins et al, which have now been updated by The International Federation of Gynecology and Obstetrics (FIGO).[13,14] PAS with invasion below the bladder trigone were excluded for uterine conservative–resective surgery because of the high risk for failure. For the purpose of this study, pregnant women with invasion below the bladder trigone invasion were also excluded from the hysterectomy group in order to only include comparable outcomes.[4,12] Specimens were microscopically examined by the pathologist to confirm the definitive diagnosis and determine the area of placental invasion.[18]

Other exclusion criteria included uterine scar dehiscence (bluish smooth appearance of lower uterine segment due to thin uterine wall without any newly formed vessel, where the placenta can mostly separate with gentle traction),[19] massive preoperative bleeding, diffuse placental invasion identified during intraoperative staging, advanced PAS grading with lower bladder–cervical invasion and/or lower parametrial invasion.[20]

Invasion below the bladder trigone can be distinguished by experienced sonographers using preoperative ultrasound identifying the increase in ultrasound abnormality signs of PAS in the lower uterine segment to the cervix.[21,22] Intraoperative staging can be carried out by opening the anterior leaf of the broad ligament and evaluating the vesico-uterine space.[23]

2.1 | Cesarean hysterectomy

In the early part of our experience, cesarean hysterectomy in women with PAS was performed after delivery of the baby via a fundal incision and IIAL, if there was persistent active bleeding from the lower uterine segment following partial manual placental removal (blunt placental removal). In these cases, we placed a modified Cho suture (brace suture) in the anterior lower uterine segment to reduce the blood loss before cesarean hysterectomy. Planned cesarean hysterectomy was also performed in cases with preoperative diagnosis of placenta increta or percreta and/or intraoperative confirmation of a bluish appearance with neovascularization (placenta increta) or placental tissue visible in the uterine serous layer with neovascularization (placenta percreta); in these cases, hysterectomy was performed after IIAL procedure without placental removal.

2.2 | Uterine conservative–resective surgery with IIAL

Over the study period, two types of uterine conservative–resective surgery evolved. Yhe first procedure was the Surabaya Modified Procedure for Uterine Conservation (SuMPUC) surgery. With the initial SuMPUC method the baby is delivered via a fundal midline incision followed by IIAL[5,24,25] and placement of a tourniquet below the lower uterine segment to achieve vascular control of this region.[26] After obtaining initial hemostasis, a bladder flap is carefully dissected with ligation of all new vessels from the bladder while stepwise lowering of the tourniquet into the para-cervical area, dissection of the abnormal placentation, and removal of the placenta along with the pathologically invaded area.[4] A modified Cho suture (brace suture) below the placental dissection area[27] was placed if bleeding occurred after the uterine tourniquet was released. Uterine closure of both incisions is completed after complete hemostasis is achieved. In most cases (32 out of 36 cases) this was followed by bilateral salpingectomy.

2.3 | Uterine conservative–resective surgery with identification—ligation of the upper vesical, upper vaginal, and uterine arteries

A midline or transversal fundal incision is performed to deliver the baby, followed by careful development of the bladder flap using the Pelosi maneuver (Figure 1),[28] and identification–ligation of vesical and vaginal arteries up to the uterine arteries.

The new concept of uterine conservative–resective surgery consisted of replacing the tourniquet with cervical area sutures in anterior and lateral cervix to control bleeding from the vascular supply coming from the lower uterine segment.[29] Just lateral of the abnormal placental invasion site, on both sites, hemostatic sutures are placed and the abnormal placental invasion is dissected, with removal of the whole placenta and closure of the anterior and fundal uterine wall. Bilateral salpingectomy was performed in most cases to prevent the next pregnancy, but not in women opting for another pregnancy.

The most recent development of this technique consisted of a one-step conservative surgical approach; instead of fundal incision, the first uterine incision is performed above the abnormal placental invasion to allow delivery of the baby.

In all cases of uterine conservative surgery, intravenous oxytocin 10 IU is administered after surgical hemostasis of the lower uterine segment has been achieved.

After surgery, PAS was confirmed by pathological examination (macroscopic and microscopic) in all placental specimens. Pathology results were compared with ultrasound findings, and

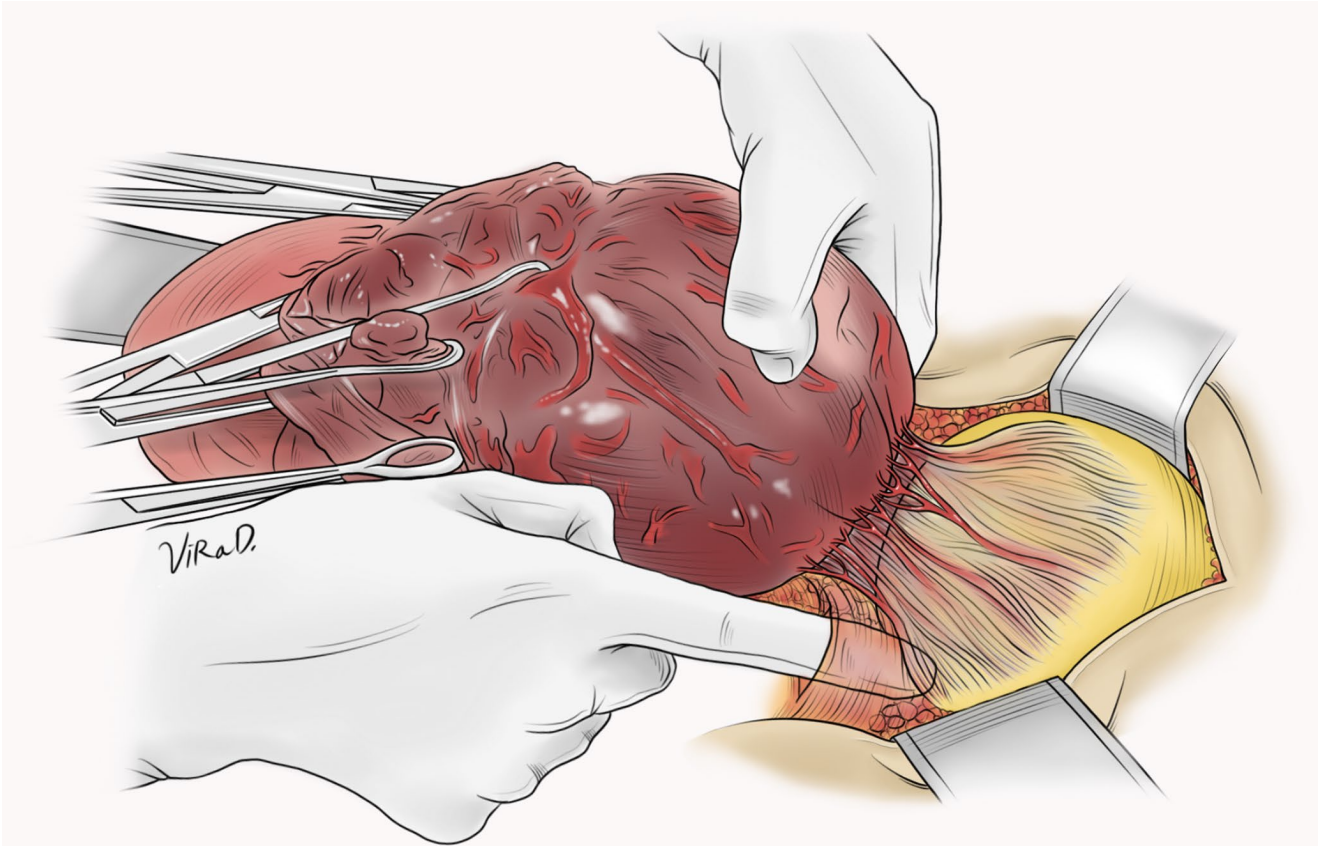

FIGURE 1 Bladder flap using Pelosi maneuver starting from lateral bladder to medial posterior bladder

the intraoperative diagnosis was compared with the final diagnosis based on agreement between surgeon and pathologist.[13,14,18]

Uterine conservative surgery was considered to have failed if bleeding did not stop after placental removal/dissection and the aforementioned hemostatic sutures of the uterine, vesical, and vaginal arteries were in place, or in case of recurrent bleeding after the abdominal wall was closed.[4]

In addition to the blood loss and laboratory results, other maternal outcomes were recorded such as maternal complications, major blood loss (>1500 mL),[30,31] catastrophic blood loss (>2500 mL),[32] massive blood transfusion (>4 units of packed red blood cells in 1 hour, >10 units of packed red blood cells in 24 hours, or replacement of 50% of total blood volume within 3 hours),[33] disseminated intravascular coagulation (platelets <100000/μL, prolonged prothrombin time–activated partial thromboplastin time, and fibrinogen level <3 g/L)[34] and intensive care unit admission.

Independent *t* test, Mann–Whitney *U* test, and chi-squared test were performed (SPSS 23, IBM) for the various maternal outcome variables where appropriate.

2.4 | Ethical approval

Ethical approval was obtained from the Ethics Committee in Health Research Dr. Soetomo Academic General Hospital number 1711/KEPK/XII/2019 on December 17, 2019.

3 | RESULTS

Out of 396 surgery-confirmed PAS cases, 234 pregnant women met the inclusion criteria (Figure 2).

Cesarean hysterectomy and IIAL were performed in all PAS cases before November 2016. Uterine conservative surgery started in November 2016 after the sharp increase in PAS cases and the massive blood loss associated with total hysterectomy. The uterine conservative–resective surgery with IIAL was performed as default from November 2016 up to November 2017, the purpose of IIAL was to reduce the blood loss in particular from the very vascular lower uterine segment.[5,6,24,25]

Delivery of the baby and final surgical procedures were performed at 34–36 weeks of gestation except if there was vaginal bleeding or there were fetal indications, and in some pregnant women as a result of late referral (Table 1). Heavy menstrual bleeding occurred in eight women 3 months after uterine conservative–resective surgery, these women had a thick endometrial line on ultrasound examination, and after treatment with tranexamic acid had further normal periods (Table 2).

Two women in the uterine conservative–resective surgery with IIAL group have been pregnant again, both delivering at 37 weeks of gestation without any complication (Table 3).

Attempts to complete conservative surgery failed in eight women (these were the eight excluded cases) because of anterior–parametrial placental invasion (two cases with blood loss 5000 mL and 4500 mL),

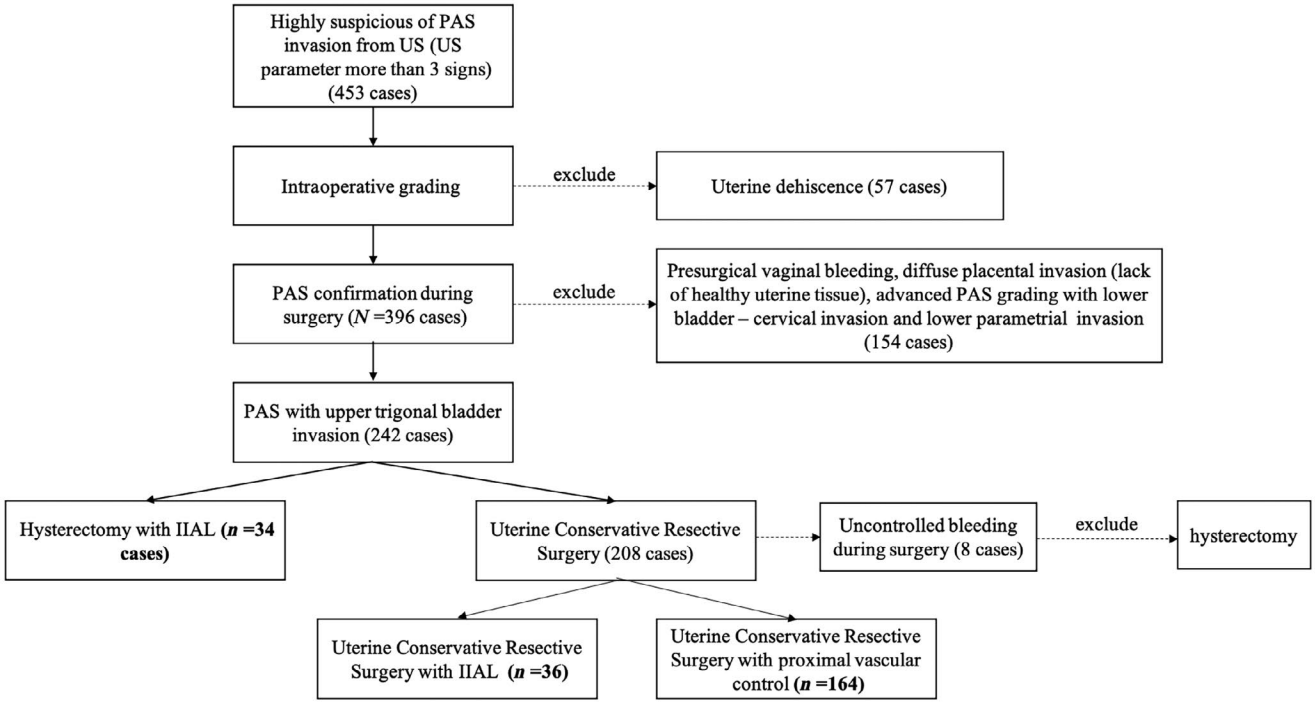

FIGURE 2 Enrollment data based on ultrasound reports, combined medical records, surgical reports, and pathology reports

TABLE 1 Maternal characteristics comparison of cesarean hysterectomy with internal iliac artery ligation vs uterine conservative–resective surgery

	Uterine conservative–resective surgery ($n = 200$)	Cesarean hysterectomy with IIAL ($n = 34$)	p
Characteristics			
Age (y), median (range) [a]	33 (19–44)	35 (26–41)	0.013
GA at diagnosis (wk), median (range) [a]	34 (21–40)	34 (28–39)	0.270
GA at surgery (wk), median (range) [a]	35 (28–40)	36 (30–39)	0.385
Number of CS, *n* (%)[b]			
1 CS	147 (73.5%)	20 (58.8%)	0.120
2 CS	42 (21%)	13 (38.2%)	
>2 CS	11 (5.5%)	1 (2.9%)	
Major implantation, *n* (%)[b]			
Accreta	60 (30%)	3 (8.8%)	0.031
Increta	93 (46.5%)	19 (55.9%)	
Percreta	47 (23.5%)	12 (35.3%)	

Abbreviations: CS, cesarean section; GA, gestational age; IIAL, internal iliac artery ligation.
[a]Mann–Whitney *U* test.
[b]Chi-squared test.

posterior placental invasion (one case with blood loss 3500 mL), cervical invasion (two cases with blood loss 4000 mL and 3500 mL), and bladder invasion below the bladder trigone (three cases with blood loss from 4000 to 5000 ml). The decision to perform a hysterectomy was taken immediately after massive bleeding occurred during surgery after resection of the placenta and failed attempts to achieve vascular control in the lower segment of the uterus.

Thirty-four of the women underwent surgery before 34 weeks of pregnancy because of recurrent minor vaginal bleeding and major vaginal bleeding while still being hemodynamically stable.

The results demonstrate that cesarean hysterectomy with IIAL is associated with more blood loss and complications compared with both uterine resective–reconstructive surgery methods. Pregnant women managed using uterine conservative–resective surgery

TABLE 2 Maternal outcome comparison of cesarean hysterectomy with internal iliac artery ligation vs uterine conservative–resective surgery

	Uterine conservative–resective surgery ($n = 200$)	Cesarean hysterectomy with IIAL ($n = 34$)	p	OR (95% CI)
Outcomes				
Mean blood loss (mL), mean ± SD[a]	1379 ± 769	3168 ± 1916	<0.001	
Hb presurgery (g/dL), mean ± SD [a]	10.5 ± 1.3	9.9 ± 1.5	0.018	
Hb post-surgery (g/dL), mean ± SD [c]	9.6 ± 1.5	8.6 ± 1.7	0.002	
Plt presurgery (/μL), mean ± SD [a]	278 615 ± 147 976	276 059 ± 88 890)	0.968	
Plt post-surgery (/μL), mean ± SD [a]	248 415 ± 222 828	165 382 ± 71 261	<0.001	
PRBC units transfused, median (range)[a]	1 (0–6)	3 (0–10)	<0.001	
Major blood loss (>1500 mL), *n* (%)[b]	68 (34%)	24 (70.6%)	<0.001	4.7 (2.1–10.3)
Catastrophic blood loss (>2500 mL), *n* (%)[b]	25 (12.5%)	22 (64.7%)	<0.001	12.8 (5.7–29.1)
Massive transfusion, *n* (%)[b]	5 (2.5%)	12 (35.3%)	<0.001	21.3 (6.9–66)
ICU admission, *n* (%)[b]	3 (1.5%)	11 (32.4%)	<0.001	31.4 (8.2–120.86)
DIC, *n* (%)[b]	1 (0.5%)	2 (5.9%)	0.056	–
Other maternal complications, *n* (%)[b]	25 (12.4%)	11 (32.4%)	0.007	3.5 (1.5–8.1)
Re-laparotomy for recurrent bleeding	2 (1%)	2 (5.9%)	0.423	–
Bladder injury	9 (4.5%)	7 (20.6%)	0.002	5.2 (1.9–16)
Vascular injury	1 (0.5%)	2 (5.9%)	0.056	–
Uterine atony	21 (10.5%)	0	0.143	–
Maternal death	0	0	–	–
Long-term follow up (6 mo)				
Fistula	1 (uterocutaneous fistula)	2 (vesicovaginal fistula)		
Heavy menstrual bleeding	8	0		
Percreta invasion	$n = 47$	$n = 12$		
GA at surgery (wk), median (range) [a]	36 (28–39)	36 (32–38)	0.797	
Mean blood loss for percreta invasion (mL), mean ± SD[c]	1926 ± 792	4875 ± 1680	<0.001	
Hb presurgery (g/dL)[c]	10.5 ± 1.5	9.1 ± 1.9	0.012	
Hb post-surgery(g/dL)[c]	9.5 ± 1.5	8.4 ± 1.3	0.024	
Plt presurgery (/μL), mean ± SD [c]	276 787 ± 85 033	273 833 ± 105 629	0.919	
Plt post-surgery (/μL), mean ± SD [c]	211 638 ± 67 705	134 833 ± 63 941	0.001	
PRBC units transfused, median (range)[a]	2 (0–6)	7 (3–10)	<0.001	
Major blood loss for percreta invasion, *n* (%)[b]	27 (57.4%)	12 (100%)	0.005	18.6 (1–333.3)
Catastrophic blood loss for percreta invasion (>2500 mL), *n* (%)[b]	13 (27.7%)	12 (100%)	<0.001	63.9 (3.5–1156.4)
Massive transfusion for percreta, *n* (%)[b]	4 (8.5%)	9 (75%)	<0.001	32.3 (6.1–169.7)
Admission to ICU, *n* (%)[b]	2 (4.3%)	8 (66.7%)	<0.001	45 (7–288)
DIC, *n* (%)[b]	0	2 (16.7%)	0.039	22.6 (1–506.7)

Abbreviations: Hb, hemoglobin; ICU, intensive care unit; IIAL, internal iliac artery ligation; PAS, placenta accrete spectrum; Plt, platelets; PRBC, packed red blood cells; DIC, disseminated intravascular coagulation.

aMann–Whitney *U* test.

bChi-squared test.

cIndependent *t* test.

TABLE 3 Maternal outcome comparison of uterine conservative–resective surgery with internal iliac artery vs identification–ligation of the upper vesical, upper vaginal and uterine arteries

	Uterine conservative–resective surgery with IIAL (*n* = 36)	Identification–ligation of the upper vesical, upper vaginal, and uterine arteries (*n* = 164)	*p*	OR (95% CI)
Characteristics				
GA at surgery (wk), median (range) [a]	35 (28–40)	35 (28–39)	0.483	
Major implantation, *n* (%)[b]				
Accreta	8 (22.2%)	52 (31.7%)	0.522	
Increta	19 (52.8%)	74 (45.1%)		
Percreta	9 (25%)	38 (23.2%)		
Outcomes				
Mean blood loss (mL), mean ± SD[a]	1701 ± 813	1307 ± 743	0.005	
Hb presurgery (g/dL), mean ± SD	10.3 ± 1.5	10.5 ±.3	0.255	
Hb post-surgery (g/dL), mean ± SD	9.4 ± 1.5	9.5 ± 1.5	0.376	
Plt presurgery (/μL), mean ± SD	267 666 ± 77 802	281 018 ± 159 377	0.789	
Plt post-surgery (/μL), mean ± SD	218 896 ± 71 676	254 915 ± 243 473	0.295	
PRBC units transfused, median (range)	2 (0–6)	1 (0–6)	0.052	
Major blood loss (>1500 mL), *n* (%)[b]	18 (50%)	50 (30.5%)	0.041	0.44 (0.21–0.91)
Catastrophic blood loss (>2500 mL), *n* (%) [b]	7 (19.4%)	18 (11%)	0.170	–
Massive transfusion, *n* (%)	1 (2.8%)	4 (2.4%)	1.000	–
Admission to intensive care unit, *n* (%)[b]	0	3 (1.8%)	1.000	–
DIC, *n* (%)	0	1 (0.6%)	1.000	–
Other maternal complication, *n* (%) [b]	6 (16.7%)	19 (11.6%)	0.408	
Re-laparotomy for recurrent bleeding	0	2 (1.2%)	0.940	–
Bladder injury	4 (11.8%)	5 (3%)	0.048	0.25 (0.06–0.99)
Vascular injury	1 (2.8%)	0	0.109	–
Uterine atony	2 (5.6%)	19 (11.6%)	0.297	–
Percreta invasion	*n* = 9	*n* = 38		
GA at surgery (wk), median (range) [a]	34 (28–37)	36 (29–39)	0.081	
Mean blood loss for percreta invasion (mL), mean ± SD [a]	2288 ± 509	1674 ± 855	0.020	
Hb presurgery (g/dL), mean ± SD [c]	10.2 ± 2.3	10.6 ± 1.3	0.447	
Hb post-surgery (g/dL), mean ± SD [c]	9.3 ± 1.6	9.6 ± 1.5	0.678	
Plt presurgery (/μL), mean ± SD [c]	230 777 ± 67 952	287 684 ± 85 757	0.071	
Plt post-surgery (/μL), mean ± SD [c]	163 222 ± 42 693	223 105 ± 67 822	0.015	
PRBC units transfused, median (range)[a]	3 (2–6)	2 (0–5)	0.086	
Major blood loss for percreta invasion (>1500 mL), *n* (%) [b]	8 (88.9%)	19 (50%)	0.059	–
Catastrophic blood loss for percreta invasion (>2500 mL), *n* (%) [b]	4 (44.4%)	9 (23.7%)	0.237	–
Massive transfusion for percreta, *n* (%) [b]	1 (11.1%)	3 (7.9%)	1.000	–
Admission to ICU, *n* (%) [b]	0	2 (5.3%)	1.000	–
DIC, *n* (%) [b]	0	0		

Abbreviations: DIC, disseminated intravascular coagulation; Hb, hemoglobin; ICU, intensive care unit; IIAL, internal iliac artery ligation; PAS, placenta accreta spectrum; Plt, platelets; PRBC, packed red blood cells.

aMann–Whitney *U* test.

bChi-squared test.

cIndependent *t* test.

with identification–ligation of the upper vesical, upper vaginal, and uterine arteries have lower blood loss compared with the uterine conservative–resective surgery with IIAL.

4 | DISCUSSION

The findings based on this large series of pregnant women with selective PAS managed in one tertiary referral hospital in East Java demonstrate that uterine conservative–resective surgery is associated with a significantly lower rate of major maternal complications when compared with cesarean hysterectomy and IIAL.

The steep increase in the number of PAS managed in our center primarily reflects the increased recognition that these pregnant women need their care provided by recognized tertiary centers with a dedicated "accreta team" in addition to the well-known increased incidence of cesarean sections in Indonesia (from 9.8% in 2013 to 17.6% in 2018).[35]

The principal of surgical strategies depends on the placental topography and on detailed knowledge of the placental–uterine vascularity.[4,29] Research by Palacios-Jaraquemada et al on uterine conservative resective surgery has demonstrated the high success rate of uterine conservative surgery for placental invasion above the bladder trigone.[12]

Mean blood loss, rate of maternal complications, and the need for intensive care unit admission for catastrophic (>2500 mL) blood loss was significantly higher in the original hysterectomy plus IIAL group compared with the uterine conservative–resective surgery group, even in placenta percreta cases. With this procedure, the possibility of bleeding from the extrauterine vascular anastomosis—damaged when clamping the lower uterine segment—can lead to massive bleeding.[29]

The first uterine conservative–resective surgery with IIAL uses a similar concept to the triple P procedure;[5] both methods focus on reducing blood loss from the uterine arteries as the major branches of IIA. Additional sutures were often needed in the lower uterine segment to control the bleeding, especially from the placental bed after placental resection and removal. However, the difference is the use of the lower uterine tourniquet approach to reduce the blood loss.

Uterine conservative–resective surgery with IIAL was associated with a higher risk of major blood loss compared with the modified uterine conservative–resective surgery with identification–ligation of the upper vesical, upper vaginal, and uterine arteries ($p = 0.041$): mean blood loss was, respectively, 1701 mL vs 1307 mL ($p = 0.005$) for all PAS grade and 2288 mL vs 1674 mL ($p = 0.020$) for percreta invasion. Kutuk et al also found higher blood loss in a hysterectomy group compared with uterine conservative–resective surgery and leaving the placental in situ for all grades of PAS, but described higher blood loss associated with uterine conservative–resective surgery in women with placenta increta and percreta while using IIAL, uterine artery, and utero-ovarian artery ligation.[36]

The higher risk of major blood loss associated with uterine conservative–resective surgery with IIAL is probably because this particular technique only focuses on the uterine artery as the branch of the internal iliac artery, while "ignoring" the vaginal arteries.

Other studies using a similar approach of vascular control in cases with invasion above the bladder trigone also found blood loss of approximately 1500 mL;[12,37] this level of 1500 mL can be used as a reasonable benchmark in uterine conservative–resective surgery.

Strategies required for developing the bladder flap are pivotal to control vascularity from the bladder to placental invasion. The Pelosi maneuver is an important step to open the vesico-uterine space and identify the location of the placental invasion during surgery.[28] This maneuver will be difficult if the placenta invades to below the lower trigonal bladder[12] and may risk damaging the new vessel and, as a result, massive bleeding.

We no longer recommend IIAL in conservative–resective uterine surgery for PAS because of the associated higher blood loss, surgical complexities, and the associated 1.8% risk of vascular injury (internal iliac artery injury).[38,39]

The International Federation of Gynecology and Obstetrics (FIGO) have reached consensus on how to standardize clinical grading of PAS; the placental topography (accreta–increta–percreta) and abnormal placental location are the critical factors determining the success rate of surgical conservative approaches. Treatment of abnormal placental invasion above the lower uterine segment has higher success rates compared with placental invasion in the lower uterine segment (lower bladder, cervix, parametrium, and posterior placental invasion) in PAS with placenta previa. Detailed preoperative placental mapping using MRI or ultrasound (abdominal/transvaginal gray-scale, abdominal/transvaginal Doppler, three-dimensional Doppler, three-dimensional volume-rendering ultrasound) have a critical role in predetermining the success of uterine conservative surgery.[40] In emergency situations like preoperative massive vaginal bleeding with hemodynamically compromised pregnant women, we do not recommend uterine conservative surgery.

The limitation of this retrospective cohort study is mainly that over the years, our experience and expertise have improved significantly and the current high success rates are closely linked to the presence of a dedicated team of experienced surgeons with the backup of a large tertiary facility. These procedures are better not done in smaller units lacking the experience.

In case an obstetrician encounters a major PAS during a cesarean section in a small peripheral hospital, the best strategy is to deliver the baby, clamp the cord, close the uterus and transfer the pregnant women to the regional tertiary facility.

5 | CONCLUSION

Cesarean hysterectomy is not the default treatment for all PAS, the pregnant woman with PAS with invasion above the vesical trigone should have uterine conservative–resective surgery because it is much safer than cesarean hysterectomy.

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CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTIONS

The study was design by RAA, AA, KEG, MPW, MIA, NIC, EE, BW, HTJ, EGD, CAB, DK, DPV, GA, GAD, and AS. It was planned by RAA, AA, KEG, MPW, MIA, NIC, EE, EGD, GAD and AS and conducted by RAA, MPW, NIC, EGD, GA, DK, DPV, and AS.

Data were analyzed by RAA, CAB, GA, GAD, and AS. All authors contributed to writing the manuscript.

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