Research Article

An internal iliac artery ligation technique for bleeding control in the placenta accreta spectrum disorder

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Abstract

Objective: To assess the contribution of internal iliac artery ligation to bleeding control during surgery.

Methods: This retrospective study used secondary data from medical records. All patients diagnosed with PASD from January 2019 – to December 2022 were included in this study. Participants were grouped based on operation technique, and the blood loss and operative duration were evaluated. The tests used were the Kruskal-Wallis and the Mann-Whitney U tests.

Results: 108 PAS patients were discovered. The most age group was between 20-35 years with parity of more than or equal to 4, history of Cesarean section once, gestational age at termination 34-36 weeks, and maternal death in 7 out of 101 cases. There were 49 resections, 13 resections with internal iliac artery ligation, 34 hysterectomies, and 12 hysterectomies with internal iliac artery ligation. There was no difference in bleeding and operative duration between resection vs. resection with internal iliac artery ligation (p: 0.113; p: 0.639), hysterectomy vs. a hysterectomy with internal iliac artery ligation ((p:0.052; P:0.723), and resection with ligation vs hystetectomy with the internal iliac artery ligation (p:0.052; p:0.723). Bleeding and operative duration differed significantly between resection vs. hysterectomy (p:0.002; p:0.013). All patients underwent tourniquet placement.

Conclusion: An Internal iliac artery ligation was not shown to reduce bleeding in treating PASD.

Keywords: accreta, internal iliac artery, placenta.

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INTRODUCTION

Placental accreta spectrum disorder (PASD) is a condition in which implantation of the placenta is abnormal. The placenta cannot be delivered spontaneously, and if manual action is performed to release the placenta, it can cause profuse bleeding and is potentially life-threatening. [1] These conditions include placenta adherent or vera, which pathologists also refer to as placenta accrete, in which the villi adhere to the myometrium surface without invading it; placenta increta, in which the villi penetrate deeply into the myometrium to reach the uterus serous layer; and placenta percreta, in which the invasive villous tissue penetrates the serous layer and reaches surrounding tissues, vessels, and pelvic organs. Placental accreta spectrum disorder can be focal or diffuse.[2]

The incidence of PASD is increasing worldwide, from 1 in 2,500 pregnancies to 1 in 500 pregnancies, primarily attributed to an increase in C-section rates. The incidence of PASD in Indonesia in 2016 was around 2% and has increased so far. Increased morbidity and mortality in mothers and fetuses are a result of PASD. The primary cause of the maternal implications is the possibility of obstetric hemorrhage, while the primary cause of the fetal implications is iatrogenic preterm. Up to 90% of

patients require blood transfusions; the usual blood loss is 3000-5000 ml. Other complications include Sheehan syndrome, respiratory distress, kidney failure, and even death. Urine, bladder, and bowel damage, as well as hysterectomy, are examples of surgical complications. That has led to a high incidence of intensive care unit admissions and extended hospitalizations.[3-5] As a result of these complications, diagnosis needs to be made before delivery and allows for multidisciplinary planning to minimize the potential for maternal or neonatal morbidity and mortality.[3]

PASD is expected to be diagnosed during antenatal care; therefore, it can be referred to a referral canter hospital to get maximum treatment for a better outcome.[6] Managing the placenta accreta spectrum is challenging for obstetricians and gynecologists because they face the risk of massive bleeding during surgery; hence, the risk of morbidity and mortality of pregnant women increases. Keeping antepartum and intrapartum hemorrhage under control is the most considerable management challenge for PASD. The primary cause of PASD associated with hysterectomy, disseminated intravascular coagulation, and maternal mortality is massive hemorrhage. There are currently no international guidelines for the best way to operate PASDs, and the ones that exist mainly address how to handle PASDs optimally.[7]

Conservative treatment is a measure to prevent hysterectomy. It is primarily intended for women who still desire to have children or due to other psychosocial considerations related to status and self-esteem. There are four methods: an extirpative technique, leaving the placenta, one-step conservative surgery, and triple P procedure.[8,9]

Some literature reports that ligating the internal iliac artery may reduce the risk of bleeding in PASD, although other studies have shown different results. Based on this, we were interested in evaluating the effectiveness of internal iliac artery ligation in reducing the amount of bleeding in cases of placenta accreta.

METHODS

This study was retrospective; the data was taken from the medical records of patients treated with PASD at Dr. Wahidin Sudirohusodo Hospital, Makassar, Indonesia, from January 2019 – to December 2022. The placenta accreta spectrum disorder was diagnosed using grayscale 2-dimensional ultrasound with Doppler imaging to assess the placenta accreta index score. A definite diagnosis is made during intraoperative and anatomical pathology examination results.

The criteria used to establish the diagnosis of placenta accreta using the placenta accreta index (PAI): history of cesarean section 2 or more times = 3, lacunae grade 3 = 3.5, lacunae grade 2 = 1.0, myometrium thickness equal to 1 mm or less = 1, more 1 mm but less or equal 3 mm = 0.5, myometrium thickness more 3 mm but less or equal 5 mm = 0.25, anterior placenta previa = 1.0, found bridging vessels = 0.5.6

There were four types of management for PASD: resection of the uterine wall, resection with iliac internal artery ligation, hysterectomy, and hysterectomy with iliac internal artery ligation. The tourniquet was tied around the uterus onto the lower edge of the invasion of the placenta at the lower uterine segment for all the patients (Figure 1). A hysterectomy was performed based on the results of an ultrasound examination when bizarre lacunae, hypervascularization in the cervix, or decided intraoperatively if the placenta invaded the posterior wall or the parametrium. The determination of Internal iliac artery ligation was not random. The Wahidin Sudirohusodo Hospital PASD team performed all operations.

Statistical tests use non-parametric tests because the distribution was abnormal, using medians for ordinal data. The tests used were the Kruskal-Wallis test for data that are more than two and not paired with each other and the Mann-Whitney U test used to see differences using median values. The study committee of Universitas Hasanuddin Medical Faculty granted ethical approval for this research (Ethical Approval No: 590/UN4.6.4.5.31/ PP36/ Z0Z3).

Figure 1. The tourniquet placement on the lower edge of the invasive placenta

RESULTS

During January 2019 – December 2022, 124 cases were diagnosed through ultrasound. Sixteen cases were excluded from the analysis, 4 cases because it was not a PASD by intraoperative, 5 cases of pathology examination results were not PASD, and 7 cases because the data was incomplete. Therefore, a total of 108 cases. The placenta accreta spectrum disorder in 2019 was 22 cases; in 2020, there were 16 cases; in 2021, there were 35 cases; and in 2022, there were 51 cases (Figure 1).

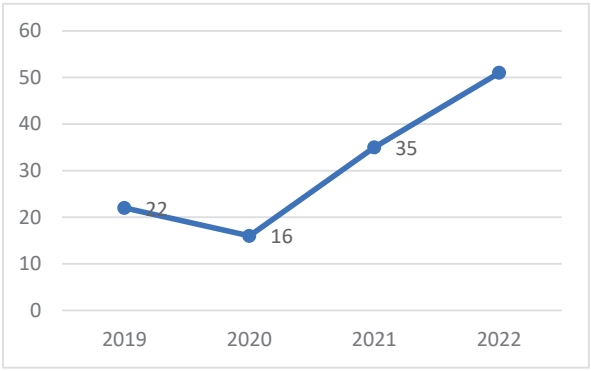

Figure 1. Number of PAS cases 2019 - 2022

In this study, PASD cases were found more in the reproductive age group, 20-35 years, multiparous, and the most was a history of cesarean section 1 time. The operative technique performed was uterine wall resection, resection accompanied by internal iliac artery ligation, hysterectomy, and hysterectomy accompanied by bilateral internal iliac artery ligation. Maternal deaths found 7 cases. (Table 1).

Table1. Sample Characteristics

Variable	Frequency	%
Age (y o)		
20 – 35	62	59.6
< 20 - > 35	42	40.4
Parity		
1	2	1.9
2	20	18.5
3	36	33.3
≥ 4	50	46.3
Number of S.C.s		
Never	4	3.7
1 x	47	43.5
2 x	45	41.7
Equal or more 3	12	11.1
Curettage history		
Never	90	83.3
Ever	18	16.7
Gestational age (weeks)		
Equal or more than 37	29	26.9
34-36	48	44.4
31-33	24	22.2
Less or equal to 30	7	6.5
Number of maternal deaths		
Live	101	93.5
Death	7	6.5

In Table 2, there was a significant difference between operation techniques on the amount of bleeding (0.003), but the duration of surgery was not different (0.082).

Table 2. Operation Technique on the Amount of Bleeding and Duration of Surgery

Operation Technique	N	Amount of Bleeding	*P-value*	Duration of Surgery	*P-value*
		Median		Median	
Resection	49	2000		135	
Resection+ ligation	13	2500		140	
Hysterectomy	34	3000	0.003	154	0.082
Hysterectomy + Ligation	12	4000		123	

Kurskal -Wallis test, $p<0.05$

The bleeding differs significantly between resection and hysterectomy cases. However, uterine artery ligation in resection did not show significant differences compared to no ligation (0.113), although the length of surgery in the two types of procedures was not significantly different (0.639). Internal iliac artery ligation in hysterectomy cases showed no significant difference in bleeding (0.210) or the length of surgery (0.154). The same was found between resection and hysterectomy with ligation; there was no difference in the bleeding or the surgery duration (Table 3).

Table 3. Comparison between Operation Technique with the Amount of Bleeding and Duration of Surgery

Operation Technique	N	Amount of Bleeding	*P-value*	Duration of Surgery	*P-value*
		Median		Median	
Resection	49	2000	0.113	135	0.639
Resection + ligation	13	2500		140	
Hysterectomy	34	3000		154	0.154
Hysterectomy + Ligation	12	4000	0.210	123	
Resection	49	2000		135	0.013
Hysterectomy	34	3000	0.002	154	
Resection + ligation	13	2500		140	0.723
Hysterectomy + Ligation	12	4000	0.052	123	

Mann-Whitney U test, P<0.05

Table 4 shows that there was a significant correlation between operative technique and the amount of bleeding (p:0.000, r 0.388), but the length of operation was not correlated (P:0.132)

Table 4. Correlation between Operation Technique to the Duration Of surgery and Amount of Bleeding

Operative action	N	r	*P-value*
Duration of operation	105	0.148	0.132
Amount of bleeding	108	0.388	0.000

DISCUSSION

The British study found that the risks for PASD were a history of cesarean section, maternal age, shorter pregnancy gap between previous cesarean section and current pregnancy, multiparity, placenta previa, assisted reproductive techniques, submucosal leiomyomas, smoking, and hypertension. Placenta previa and cesarean section were previously two of the most known risk factors.[10] PASD risk factors in Australia and New Zealand are older maternal age, previous cesarean section, placenta previa diagnosed before birth, and multiple births.[11]

In our study, PASD was more common in women of reproductive age, and in women with a history of cesarean section once, termination was primarily performed after more than 34 weeks of pregnancy with 6.5% maternal mortality.

Proper development of the placenta is the primary condition for a healthy pregnancy. The trophoblast invades the uterine decidua and then the uterine spiral artery; therefore, the artery dilates to ensure an adequate blood supply continues to the growing fetus. The invasion process is more enhanced in PASD. Extra villous trophoblast cells invade deeper and show more mesenchymal phenotypes than normal placentation, even continuing into the third trimester. In addition to excessive extra villous trophoblastic invasion, abnormal maternal vascular remodeling or neo-angiogenesis is one factor that triggers an increased invasion of the deeper placenta.[12]

PASD is linked to substantial aberrant neovascularization; therefore, blockage of several pelvic arteries can still result in more significant blood loss via collateral vessels. Several surgical procedures, i.e.,Internal iliac artery ligation, uterine devascularization, uterine compression sutures, uterine balloon tamponade, and pelvic tamponade, are performed to control severe intraoperative bleeding in women with PASD. There are no randomized controlled trials that examine how well various methods work to limit maternal blood loss during childbirth. Consequently, the operator's experience and resources should be considered while choosing the preferred procedure. According to a reasonable strategy, the easiest method with the lowest risk of complications should be used first.[1]

It is necessary to prepare preoperative maximum to avoid complications, such as preparing for the surgery team, blood transfusions, and stable preoperative maternal hemodynamics. Managing the PASD at Dr. Wahidin Sudirohusodo Hospital involves a multidisciplinary consisting of a maternal-fetal medicine consultant, oncologist, urologist, vascular surgery, anesthesiologist, and neonatologist. Blood preparation follows a massive transfusion procedure, providing as many as 24 bags of blood with eight packed red cells, eight whole blood, eight fresh frozen plasma, and eight thrombocyte concentrates.

Of the 108 cases of PASD operated on at Dr. Wahidin Sudirohusodo Hospital, most were carried out through planned surgery, and about 40.5% were treated conservatively. Conservative treatment was done by doing one-step conservative surgery. The operative action was preceded by the installation of a

ureteral stent by urologists to avoid ureteral trauma. Hysterotomy was performed in the corpus uteri to deliver the baby to avoid the placental insertion area in the uterus's lower segment. After the baby was born, intramural and intravenous fluid uterotonic injections were performed. Exploring the expansion of placental attachment and conducting trials by stretching the umbilical cord, if it appears that uterine tissue was attracted inward, it could be established that the placenta is attached to the endometrium unless there was bulging or percreta or purplish shadow. The following action was the installation of a tourniquet using ureteral catheter no. 16 in the lower segment of the uterus at the boundary of placental insertion for hemostatic purposes, then releasing the vesicouterine plica down while doing hemostatic with cautery or sutures. After the lower limit of the placenta was reached, resection of the involved uterine area was carried out, and suturing of the uterus was performed. In some cases, hemostasis was performed by iliac internal artery ligation first (12% resection and ligation and 11.1% hysterectomy and ligation).

In the case of total placenta previa, the placenta gets a significant amount of blood supply from the descending branches of the cervical and vaginal arteries. The artery continuously perfuses blood into the lower segment of the uterus even after the uterine artery ligation, thus still failing to control bleeding. In such cases, uterine artery ligation measures effectively reduce blood flow to uterine, cervical, and vaginal veins. Ligation of the internal iliac artery reduces the risk of a hysterectomy. It becomes easier if a hysterectomy is still performed, as ligation will help reduce bleeding.the Hence, the surgical field becomes more apparent and avoids trauma to other organs, especially the ureters.[13]

Our results showed that the operative type of action significantly differed in the amount of bleeding. The difference was significant, especially for resection compared to hysterectomy. Hysterectomy was decided if vascularization was found in the cervical region by ultrasound, large and numerous lacunae, and intraoperative if extensive attachment was found to the parametrium or the posterior corpus. The results showed that performing the internal iliac artery ligation for resection and hysterectomy did not significantly differ in bleeding. Operative action did not correlate with the length of surgery but did correlate with the amount of bleeding.

Our results were no different from those reported by Iwata et al. that among the 23 cases performed with or without the internal iliac artery ligation showed no significant difference in the amount of bleeding or length of hospitalization. Uterine artery ligation and cervical tamponade were simple and effective measures to control bleeding when releasing placenta accreta.[14,15]

According to Wagaarachchi and Fernando 18 and Nizard et al., bilateral internal iliac artery ligation was a safe and successful treatment for obstetric hemorrhage-related conditions that threatened life in order to save the uterus. Fifty percent of the twelve patients who had bilateral iliac artery ligation were able to conceive again.[16,17]

A meta-analysis of 795 patients and found that internal iliac artery ligation did not decrease the amount of bleeding and maintain the uterus. In contrast, uterine artery ligation accompanied by uterine tamponade significantly reduced bleeding volume.[18]

Surgical7 methods using tourniquets and forceps, when necessary, could improve the outcome of surgery in severe cases of placenta accreta spectrum, i.e., the amount of bleeding becomes less during surgery, especially for lower placental insertions.

STUDY LIMITATIONS

This study was retrospective. Consequently, it relies heavily upon medical records, which are often incomplete. Determining cases performed by resection or hysterectomy or accompanied or not by internal iliac artery ligation was not random but depended on the ultrasound examination results, whether focal or diffuse and during operation. The duration of the surgery and the amount of bleeding depend on the records in the operating room.

CONCLUSION

Internal iliac artery ligation during both uterine resection and hysterectomy did not show a significant difference in the amount of bleeding. However, the ligation did not affect the length of surgery compared to procedures without ligation. Further research needs to be done with a more significant number of samples and with randomization methods to obtain better results. In all cases, a tourniquet was applied to prevent bleeding; this can be considered a modality to reduce the bleeding. However, further research is still needed.

CONFLICT of INTERESTS

The authors declare that there is no conflict of interest.

Informed Consent

Informed consent was obtained from each subject and their husband or parents.

ETHICAL APPROVAL

This study was conducted with ethical approval from the Hasanuddin University Research Ethics Commission, under Number 590/UN4.6.4.5.31/ PP36/ Z0Z3.

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