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Systematic Review

Comprehensive Analysis of Artery Ligation Intervention in Placenta Percreta Management: A Systematic Review

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KEYWORDS
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ABSTRACT

Introduction: The artery ligation technique has been adopted as a life-saving strategy to minimize bleeding in obstetrical and pelvic procedures. However, there are only a few studies on the use of arterial ligation in surgeries for abnormally invasive placentation (AIP). The purpose of this systematic study is to assess how well arterial ligation in managing blood loss during placenta percreta surgery and assess the associated complications and adverse events.

Material and Methods: Systematic Reviews and Meta-Analyses Preferred Reporting Items (PRISMA) framework was used in this study. Studies on arterial ligation techniques in placenta percreta surgery were included based on criteria focusing on estimated blood loss, operative time, and adverse events. A comprehensive literature search across multiple databases was performed, resulting in three studies that met the inclusion criteria.

Results: The three studies included in the review with a total of 193 patients. The findings show that IIAL significantly decreased the projected amount of blood loss compared to control groups. In one study, bilateral IIAL showed lower blood loss (1076 ± 545 ml) compared to other interventions, while another study demonstrated that IIAL resulted in lower estimated blood loss compared to control groups. However, hypogastric artery ligation (HAL) was associated with higher blood loss in one study. Despite its effectiveness in controlling blood loss, complications such as common iliac artery thrombosis, pseudoaneurysms, and limb ischemia were reported, though with low incidence.

Conclusion: Arterial ligation, particularly IIAL, could be a viable strategy for managing blood loss during placenta percreta surgery.

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INTRODUCTION

The clinical manifestation of abnormal invasive placentation (AIP), whose etiopathogenesis is unknown, occurs when the placenta cannot be detached from the uterine. and is often associated with poor maternal outcomes during delivery due to postpartum hemorrhage [1]. AIP is divided into some classifications depending on the extent of placenta accreta invasion into the uterine wall, increta, and percreta [1,2]. Prevalence of AIP increased over the past decades from approximately 1 in 4000 deliveries into 1 in 2500 in 1990, and recently affects from 0.17-0.34% of deliveries; these emerging cases significantly attributed to the prevalence of caesarean deliveries [2–8].

The most severe form of improperly invasive placentas is placenta percreta, which has a markedly increased risk of maternal morbidity. It often invades the bladder wall and can lead to extensive adnexal hypervascularization, making caesarean delivery more complex and increasing the likelihood of complications during and after surgery [1,9]. Although there is currently no consensus on how to treat placenta percreta, the conventional therapy is a cesarean hysterectomy. Conservative methods are being investigated as possible substitutes.

The artery ligation technique has been adopted as a life-saving strategy to minimize bleeding in obstetrical and pelvic procedures. However, there are only a few studies on the use of arterial ligation in surgeries for

abnormally invasive placentation (AIP), particularly placenta percreta, and most of these studies involve a limited number of patients.8 Therefore, we used the most recent relevant studies to conduct this systematic review to explore the potential of arterial ligation in managing placenta percreta patients [10].

MATERIAL AND METHODS

The PRISMA were adhered to in this review framework [11,12].

Eligibility Criteria

To improve the review's specificity, inclusion and exclusion criteria were decided upon prior to the literature search. Randomized controlled studies and observational studies that were published within the past ten years met the inclusion criteria. Placenta percreta patients in general, including convolution of complications patients, etc., are included in the sample population. As part of the intervention, the patients received arterial ligation in various forms, including hypogastric artery ligation and bilateral internal iliac artery ligation. The inclusion criteria are based on the PICOS framework and include 1) Population: pregnant women diagnosed with placenta percreta patients; 2) Intervention: artery ligations; 3) Comparison: patients treated with cesarea hysterectomy therapy or placebo group; 4) Outcome: delta operative duration time, adverse events, and estimated blood loss; 5) Research methodology: observational study and randomized controlled trial (RCT); exclusion criteria were: 1) unrelated to the research's purpose; 2) non-human trials and studies; 3) clinical trials; 4) non-English studies; 5) grey literature.

Search Strategy

From March 26 to April 30, 2024, three independent researchers (SL, CY, and NA) searched the literature. Numerous databases were utilised, such as ScienceDirect, PubMed, Google Scholar, and the Cochrane Journal. The keywords used ("Placenta percreta" OR "Placenta previa percreta" OR "adhesive placenta") AND ("artery ligation" OR "ligation" OR "internal iliac ligation" OR “hypogastric ligation”).

Data Extraction and Analysis

Three authors (NA, CY, and SL) separately extracted the chosen studies into a Google Sheet, and then all authors evaluated the studies' correctness and eligibility. The other authors overseeing the process, ARW, then examined and documented them. Discussions were used to settle disagreements that arose during the writing process.

Risk of Bias Assessment

The Cochrane Risk of Bias Tool 2 for Randomized Controlled Trials has five domains: outcome measurement, missing outcome data, variations from intended interventions, randomization method, and selection of reported outcomes were divided into three categories according to the quality of the study: low, moderate, and high risk of bias. The process was overseen by other authors and was used to evaluate bias risk in the studies that NA had chosen.

Outcome of Interest

The mean changes in estimated blood loss, and operative time from pre-intervention to post-intervention in each of the included studies were the focus of this review. The outcome of interest in this study is estimated blood loss, which determine the number of blood loss during the operation and operative time, determined by how long the operation undergo.

RESULTS AND DISCUSSION

Study Selection and Identification

After the literature search, 4.246 articles were published over the years from four databases. Several articles were excluded due to duplication of studies (n = 5). There are 4.186 articles excluded due to ineligible data, such as review articles and books, and inaccessible articles due to subscriptions. Then, many journals do not adhere to the intended study design with inclusion criteria (n = 39). Fig.1 shows the PRISMA flowchart. Thus, 3 articles were included in the systematic review. Out of the three studies, estimated blood loss (EBL), operative time, and adverse events were analyzed as the outcome of interest while using artery ligation as an intervention.

Risk of Bias Assessment

Based on the risk of bias assessment, four studies have an unclear risk of bias because of ambiguous statements and explanations about the methods used in the studies, which means they did not comply with the requirements of the first, second, and fifth domains of the Cochrane Risk of Bias Tool 2. The remaining studies are thought to have a low-risk bias (Fig.2). Most of the data examined have been covered in detail, despite the included studies' varied levels of bias. Reviewers concluded that the data were appropriate enough for this analysis.

Summaries of the Included Studies

This review included three studies. The artery ligations are used in two approaches: bilateral internal iliac artery ligation and hypogastric artery ligation. This

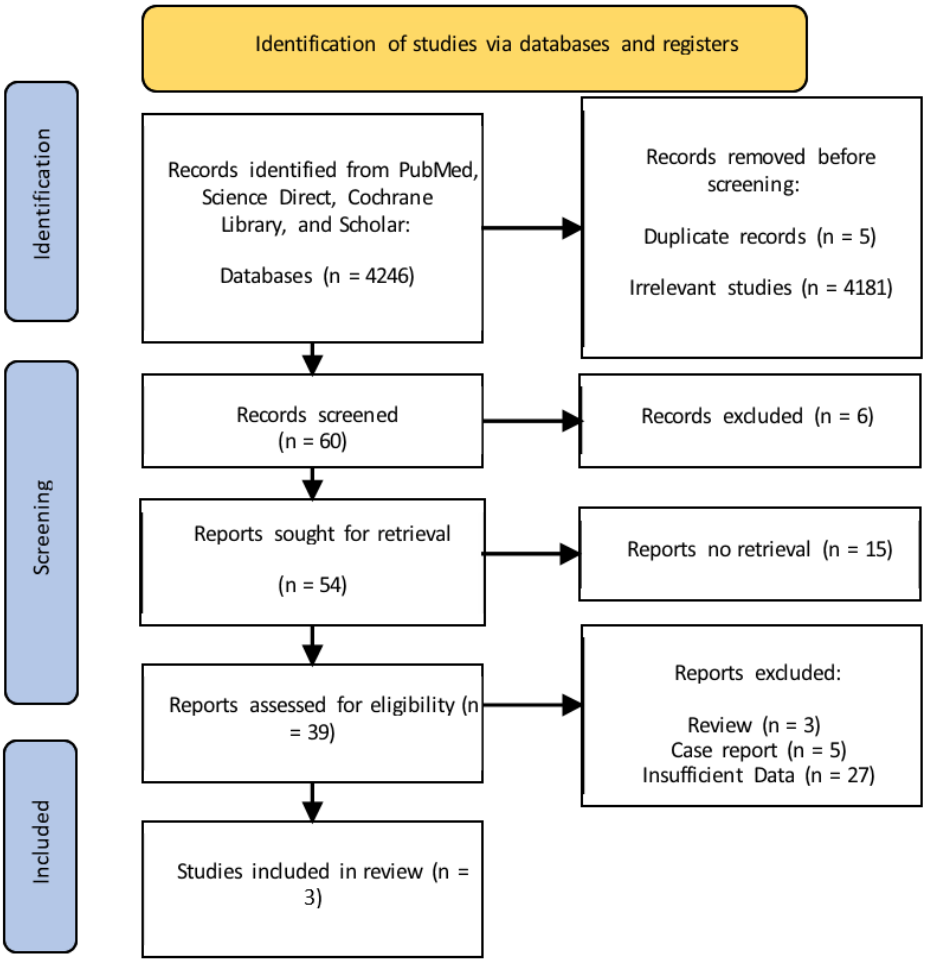


Fig.1. PRISMA Flowchart

approach was also compared with vasopressin injection. A total of 193 patients with pregnancy convoluted by placenta percreta were included as participants. The duration of the intervention ranges from 2 to 24 months. Table 1 displays the studies that were included.

Estimated Blood Loss (EBL) Analysis

Data on mean EBL changes from baseline to post-intervention were presented in seven studies. Omar and Galal compared three interventions between vasopressin injection, bilateral internal iliac artery ligation (IIAL), and control. IIAL showed a lower mean estimated blood loss compared to other groups with (1076 ± 545; $p < 0.001$), with the case of major blood loss (> 1500 ml) significantly lower (2 [10%]; $p = 0.026$). In line with Sucu et al., a retrospective study, the EBL in the IIAL group was lower than control group (993 ± 493.43; $p = 0.862$), and the postoperative hemoglobin was greater than control group (10.39 ± 1.35; $p = 0.064$). In contrast with Kuhn et al., that stated there was no statistically significant difference in the total EBL between the study and control groups. Hypogastric artery ligation (HAL) showed a higher EBL compared to the control (1000 ± 800; $p = 0.14$), but postoperative hemoglobin levels were greater than the control group (11.0 ± 1.7; $p = 0.62$). Three studies in this article lack detailed reporting on the demographic characteristics of patients, including age, parity, and medical history. Consequently, potential confounding factors influencing the outcomes cannot be further analyzed.

Both studies that explore the use of bilateral internal iliac artery ligation (IIAL) for controlling placental accreta bleeding present the operation as a way to limit intraoperative blood loss after cesarean hysterectomy in patients with placenta percreta or placenta previa. Sucu et al retrospective investigation found that IIAL was conducted prophylactically before cesarean hysterectomy in patients with placenta percreta. This

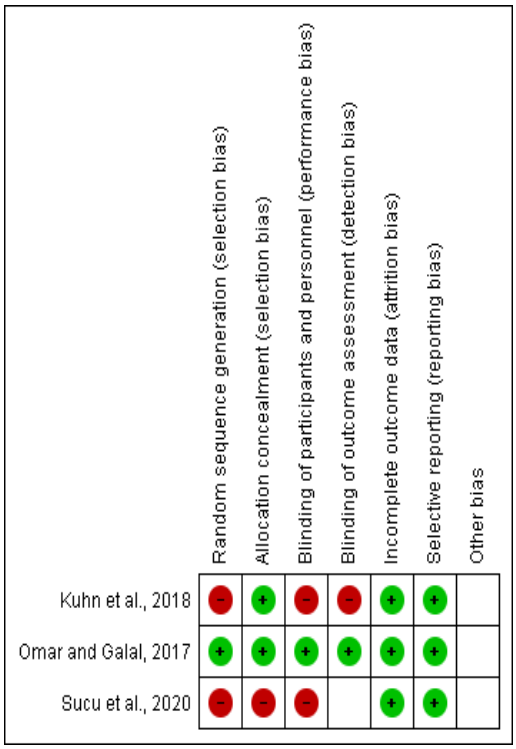


Fig.2. Risk of Bias

method attempted to reduce hemorrhagic risk by blocking blood flow to the afflicted location before the surgical operation [10,13].

Omar et al randomized controlled experiment, on the other hand, included IIAL after a vasopressin injection at the placental location. Vasopressin was used in this investigation to cause vasoconstriction and lower local blood flow. If this approach proved insufficient, IIAL was used as an extra precaution to control bleeding. In this study, the control groups were separated between those who had vasopressin injections at the placental location, followed by IIAL if necessary, and those who underwent IIAL immediately [13].

According to previous studies, although bilateral IIAL can reduce postpartum hemorrhage by 40% to 100%, the skills and experience of the surgeons are very important. Surgeon must be aware of potential side effects such as peripheral nerve injuries, ureteral ligation or laceration, hypogastric vein injury, and external iliac artery ligation. While the HAL procedure theoretically causes reduced blood flow by causing a drop in pulse pressure that converts the arterial system into a venous system, which lowers blood flow and, consequently, prevents blood loss. HAL may cause surgical consequences such as buttock claudication, internal iliac vein perforation, hypogastric nerve plexus damage, and ureteral damage. Abnormal placentation complexity, level of invasion, patient BMI, and the patient's anatomy and ability to undergo the treatment bilaterally may have influenced the decision to utilize prophylactic HAL. [10,14].

Operative Time Analysis

The included studies demonstrate that operative time significantly increases in the internal iliac artery ligation group compared to the vasopressin injection and control group (92.5 ± 35.8; $p < 0.001$). Sucu et al. also support these results within the control group (101.4 ± 29.95 vs 95.65 ± 32.64; $p = 0.190$). Kuhn et al. reported no difference in operative time compared to the control group (4.8 ± 6; $p = 0.79$) [10,14].

Globally, the number of people with placenta percreta has been steadily rising in recent years. Because it can cause major bleeding, this illness poses a serious risk to the health of the mother [10]. The ability to reduce blood loss during surgery is critical for managing this condition. Inserting inflatable balloons into the pelvic arteries—specifically, the anterior divisions of the internal iliac arteries—has become standard procedure in a number of locations. Unplanned instances without occlusive arterial balloons implanted before surgery were later shown to have a 6-fold higher incidence of major blood transfusions and a 20-fold higher incidence of coagulopathy [15].

However, there is a possibility of vascular injury due to a calibration failure that ultimately resulted in the patient's arterial rupture, this method also takes longer. Additionally, pregnancy-related arterial endothelial remodeling and hemodynamic changes brought on by CS and hysterectomy may increase the risk of arterial rupture. Calibration accurately before inflating the catheter balloon may prevent artery rupture caused by inflatable balloons [15]. An alternate tactic inside the surgery was to ligate the identical anterior divisions of the internal iliac arteries [13]. Movahedi et al. [16] performed hypogastric (internal iliac) artery ligation within 19 cases of placenta percreta, demonstrated to be successful in minimizing blood loss and facilitating surgery without visceral damage. In comparison to the control group, IIAL reduced perceived difficulties and enhanced eyesight since the surgical technique was less bloody and challenging. Previous studies retrospectively also shown that the estimated blood loss were decreased compared with the control group in placenta accreta patients [17–20]. It potential to decreases pulse pressure, limiting the pelvic blood flow [8]. These studies support our result form two studies included that IIAL reduced blood loss and had a lower adverse event.

Complications from these management techniques should be closely monitored. According to reports, complications from bilateral hypogastric artery ligation can include unilateral arterial rupture, bilateral pseudoaneurysms, thrombosis of the common iliac artery, and acute limb ischemia, reduced blood supply to

both legs because of unilateral external iliac artery thrombosis and thrombus [21–23]. Despite the low rate of adverse events, it is crucial to evaluate if internal iliac artery ligation (IIAL) reduces maternal morbidity and death linked to large bleeding after placenta percreta surgery.

The number of PRBC units transfused is not significant between IIAL and control group and the operative time is longer than the control group [10,13,24]. Despite its promise, more investigation is required to determine whether this method is a useful substitute. Overall, this method has less hazards associated with the treatment and could be a preferable choice.

CONCLUSION

Given these findings, IIAL could be considered a viable option for managing blood loss during placenta percreta surgery, but caution should be exercised due to potential complications. To evaluate the safety, efficacy, and overall advantages of IIAL in comparison to alternative methods in lowering maternal morbidity and death linked to large bleeding after placenta percreta surgery, more investigation and long-term studies are required. Despite its promising outcomes, additional evidence is required to establish IIAL as a standard practice, with a focus on balancing its benefits against the risk of adverse events.

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CONFLICT OF INTEREST

In the interest of transparency, the authors affirm the absence of any conflicts of interest pertaining to the publication of this manuscript.

Availability of Data and Materials

The data corpora generated and/or examined during this investigation are documented within the accompanying reference list.

Ethics Approval and Consent to Participate

This investigation, by its design, excluded both human and animal subjects, thereby precluding the necessity for ethical approval and participant consent.

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Table 1. Summaries included Studies

Study Study Design Population Patients	Intervention	Doses	Characteristics			Adverse Effect
			Sample (n)	Sample Age Mean (SD)	Summary of Results	
Omar and Galal, 2017 [15] RCT Pregnant women with placenta percreta	Bilateral internal iliac artery ligation (IIAL)	N/A	20	34.7 (9,10)	Estimated blood loss was lower in the IIAL group compared to the vasopressin injection and control group, with mean 1076 ml, 1123 ml, and 1664 ml, respectively (P < 0.05). Operative time in IIAL was significantly prolonged compared to the vasopressin group and control group, with 92.5 (35.8) minutes (P < 0.05). Operative outcome was preferred in IIAL group compared to the control group with lower need of hysterectomy, adverse events of DIC, and ICU admission post-operatively (P > 0.05).	N/A
	Vasopressin injection	Four units of vasopressin in 20 mL of saline	20	32.4 (2,13)		
	Control	N/A	20	33.1 (5,11)		
Sucu et al., 2020 [8] Retrospective Pregnant women with placenta percreta	Bilateral internal iliac artery ligation (IIAL)	N/A	50	32.03±4.96	Estimated blood loss in IIAL group was lower than control group (993 ± 493.43 vs 1019.57 ± 549.29 ml) (P > 0.05) Operation time in IIAL group was longer than control group (101.4 ± 29.95 vs 95.65 ± 32.64 min) but not statitsitically significant (P > 0.05) Maternal ICU admission was less than control group, but the number of complication were not different statistically.	Bladder injury (18%), internal iliac artery damage (2%), internal iliac vein damage (4%), Pelvic hematoma (2%)
	control	N/A	46	31.17±4.5		
Kuhn et al., 2018 [16] Retrospective Pregnant women with placenta percreta	Hypogastric Artery Ligation (HAL)	N/A	11	34 ± 6	From intraoperative data, presurgical data hemoglobin between HAL and control were not statistically different (11.4 ± 1.0 vs 11.1 ± 1.0) (P >0.05). Delta hemoglobin pre- and post-surgery values were not significantly different between groups (-0.8 ± 1.5 vs -0.2 ± 2.0) (P >0.05). Estimated blood loss between groups were no difference between groups, but not statistically significant (P > 0.05).	N/A