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The Role of Bilateral Internal Iliac Artery Ligation in Minimizing Blood Loss Prior to Cesarean Hysterectomy Patients with Abnormally Invasive Placenta

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Abstract: *Background*: Abnormally invasive placenta (AIP) is a term that describes cases in which there is complete or partial failure of separation of the placenta from the uterine wall following delivery of the fetus. *Objective*: to detect the role of bilateral internal iliac artery ligation in minimizing blood loss, prior to performing Cesarean Hysterectomy in cases with confirmed preoperative or intraoperative diagnosis of Abnormally invasive placenta. *Patients and Methods*: The study was carried out at Ain shams university maternity hospital in 2019. Women were recruited from the labor ward who underwent CS Hysterectomy. The total number of pregnant women enrolled in the study was 95 women. Approval from the Medical Ethics Committee were obtained. *Results*: Our study showed that internal iliac artery ligation in CS hysterectomy cases for AIP has non significant lower blood loss than cases who did not underwent internal iliac artery ligation. In stead, it had increased the operative time. In comparison of 45 patients underwent internal iliac artery ligation and 45 without ligation blood loss was non significantly lower in the group who underwent ligation with mean 1933 ml blood loss in comparison with 2117 ml in the group who did not. *Conclusion*: Bilateral internal iliac artery ligation, in cases of AIP undergoing caesarean hysterectomy, is not recommended for routine practice to minimize blood loss intraoperatively.

Keywords: Abnormally Invasive Placenta, Caesarean Hysterectomy, Internal Iliac Artery Ligation, Blood Loss

1. Introduction

1.1. Background

Abnormally invasive placenta (AIP) is a term that describes cases in which there is complete or partial failure of separation of the placenta from the uterine wall following delivery of the fetus [1].

Abnormally invasive placenta has become a main cause for maternal morbidity and mortality in both low and high-income countries [2].

Surgical complications as urologic and bowel injuries, infection, fistula formation, and systemic complications associated with massive blood loss and transfusion are the main causes of morbidity. Also, there is a marked rise in maternal mortality reaching 7% in cases associated with abnormally invasive placenta [3].

Previous caesarean section (CS) delivery is the most important risk factor associated with the increased incidence of abnormally invasive placenta. Planned Cesarean Hysterectomy is the recommended management technique in abnormally invasive placenta according to ACOG to reduce the complications such as massive bleeding, risks of disseminated intravascular coagulation, infection, acute respiratory distress syndrome, renal failure, and death [4, 5].

Cesarean hysterectomy (CH) for abnormally invasive placenta is considered as one of the most challenging surgeries: with an average mortality rate of 4.8% for emergency peripartum hysterectomy. Although lower mortality rates may be recorded in elective than emergency surgery, still Caesarean Hysterectomy for Abnormally invasive placenta remains the most difficult obstetric surgery.

Intraoperative bleeding was found to be the major cause of mortality in Cesarean Hysterectomy cases. The primary focus

of the adopted techniques was to reduce the pelvic circulation, supplied mainly from the internal iliac arteries or their branches.

Internal Iliac Artery ligation has been a surgical technique utilized to reduce hemorrhage during pelvic and obstetrical surgeries. Hypogastric artery ligation has the potential of being a life-saving measure that has been used when other more common modalities fail [6].

The technique has been used to reduce pelvic blood flow when intraoperative hemorrhage is anticipated [7].

The theoretical physiological change that occurs after internal iliac artery ligation is a decrease in pulse pressure transforming an arterial system into a venous system, which decreases blood flow and therefore blood loss.

1.2. Aim of the Work

The aim of this study is to detect the role of bilateral internal iliac artery ligation in minimizing blood loss, prior to performing Cesarean Hysterectomy in cases with confirmed preoperative or intraoperative diagnosis of Abnormally invasive placenta.

2. Patients and Methods

2.1. Methods

The study was carried out at the Ain shams university maternity hospital in 2019. Women were recruited from the labor ward who underwent CS Hysterectomy. The total number of pregnant women enrolled in the study was 122 women. Approval from the Medical Ethics Committee were obtained.

2.1.1. Study Design

Prospective Non-Randomized Trial.

2.1.2. Sample Size Justification

Using PASS11 Program for sample size calculation, and according to Iwata et al. [8], the expected mean intraoperative blood loss in patients without Internal Iliac Artery Ligation=5000±3000 ml and in patient with Internal Iliac Artery Ligation=3700±2000 ml, sample size of 45 patients in each group (total 90 patients) can detect this difference with power 80% and significance level 0.05.

2.1.3. Research Methodology

(i). Inclusion Criteria

Cases with ultrasound showed evidence of abnormally invasive placenta (multiple lacunae, loss of hypoechoic retroplacental zone, and abnormal uterine serosa – bladder interface).

(ii). Exclusion Criteria

Patients who undergo emergency cesarean hysterectomy. Cases with bleeding disorders example: (Thrombocytopenia or anticoagulant therapy) Cases with past history of visceral trauma in previous surgery for example: previous cesarean section with bladder injury.

The assignment of each patient to any of the 2 groups underwent according to the view of the managing surgical team.

2.2. All Patients Will Undergo the Following

2.2.1. History Taking

Personal history: Name, age, gravidity, parity, special habits. Current problem / complaint (bleeding, pain). History of current pregnancy (details of the 1st, 2nd & 3rd trimester). Menstrual & gynecological history: LMP details (for dating of pregnancy (EGA) and calculation of EDD). Regular or irregular cycles, Length of the cycle, OCP, Surgical procedures.

2.2.2. Past Obstetric History

Outcome of previous pregnancies in details including the abortions. Any significant antenatal, intrapartum or postpartum events. Previous maternal complications. Mode of delivery.

2.2.3. Past Medical Surgical History

Medical disorders (bleeding disorders). Drug History: (anticoagulants or anti platelets).

2.2.4. General Examination

General condition. Height, Weight. (BMI →Kg / m^2). Pulse → (tachycardia in case of bleeding or anemia). Blood pressure → (for diagnosis of hypertension or shock in from bleeding). Pallor, cyanosis. Skin for scars of previous surgeries.

2.3. Clinical Examination

2.3.1. Inspection

Size: huge in twins and polyhydraminos. Scars, movement with respiration, pigmentations, hernia orifices.

2.3.2. Palpation

Fundal level: by hand or in cm above S. Pubis.

2.3.3. Vaginal Examination

Not done.

2.3.4. Investigations

Complete blood picture (CBC), Rhesus factor (RH), Blood group.

2.3.5. Ultrasound

It will be carried out in the special care center of the fetus unit (Ain Shams University Maternity hospital). 3D power Doppler on placental site.

2.3.6. Surgical Technique

Abdominal incision (transverse or midline). Uterine incision: (transverse lower segment or upper segment). After delivery of the fetus, cord will be clamped and ligated. No attempt will be made for placental delivery. The uterine incision will not be closed. Any blood loss till this step will be noted but will not be included in the final calculation of the procedure related to blood loss. For patient planned for

bilateral internal iliac artery ligation, the procedure will be done as follows: Incision of the parietal peritoneum over the bifurcation of the common iliac artery that will be identified by palpation. Ureter will be identified and displaced with the medial peritoneal flap. The periarterial connective tissue over the internal iliac artery will be incised using a non-toothed forceps with dissecting scissor, 2-3 cm caudal to the bifurcation to place the suture over the anterior division of the internal iliac artery and spare the posterior division. The suture is then placed by using a right angled clamp passed from lateral to medial and the vessel ligated with a single ligature. The pulsations of the ipsilateral dorsalis pedis artery is checked to exclude encroachment of the ligature to the external iliac artery. The same procedure is then carried out. The CS Hysterectomy will be then completed routinely. Blood loss will be assessed by adding the following: Blood collected in the suction- irrigation device. Towels: the difference in weight of the towels and drapes placed beneath the patients and those placed vaginally, using following formula: (WET Item Gram Weight – DRY Item Gram Weight=milliliters of blood within the item).

2.3.7. Surgeons

The procedure was carried out by or under the supervision of the professor / clinical lecturer on call.

2.3.8. Recorded Complication

Visceral trauma for example: bladder or intestinal injuries. Vascular trauma for example: internal iliac veins and the need for vascular surgery intervention.

2.3.9. Outcomes

Primary outcome: estimated blood loss calculation Secondary outcome: Operative time from the delivery of the fetus till the end. Hemoglobin drop post operatively. Need for blood transfusion.

2.4. Statistical Analysis

Statistical Methods

The collected data was coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 22.0, IBM Corp., Chicago, USA, 2013.

Descriptive statistics was done for quantitative data as minimum& maximum of the range as well as mean±SD (standard deviation) for quantitative normally distributed data, median and 1st & 3rd inter-quartile range for quantitative non-normally distributed data, while it was done for qualitative data as number and percentage.

Inferential analyses was done for quantitative variables using Shapiro-Wilk test for normality testing, independent t-test in cases of two independent groups with normally distributed data and Mann Whiteny U in cases of two independent groups with non-normally distributed data. In qualitative data, inferential analyses for independent variables was done using Chi square test for differences between proportions and Fisher's Exact test for variables with small expected numbers. The level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

3. Results

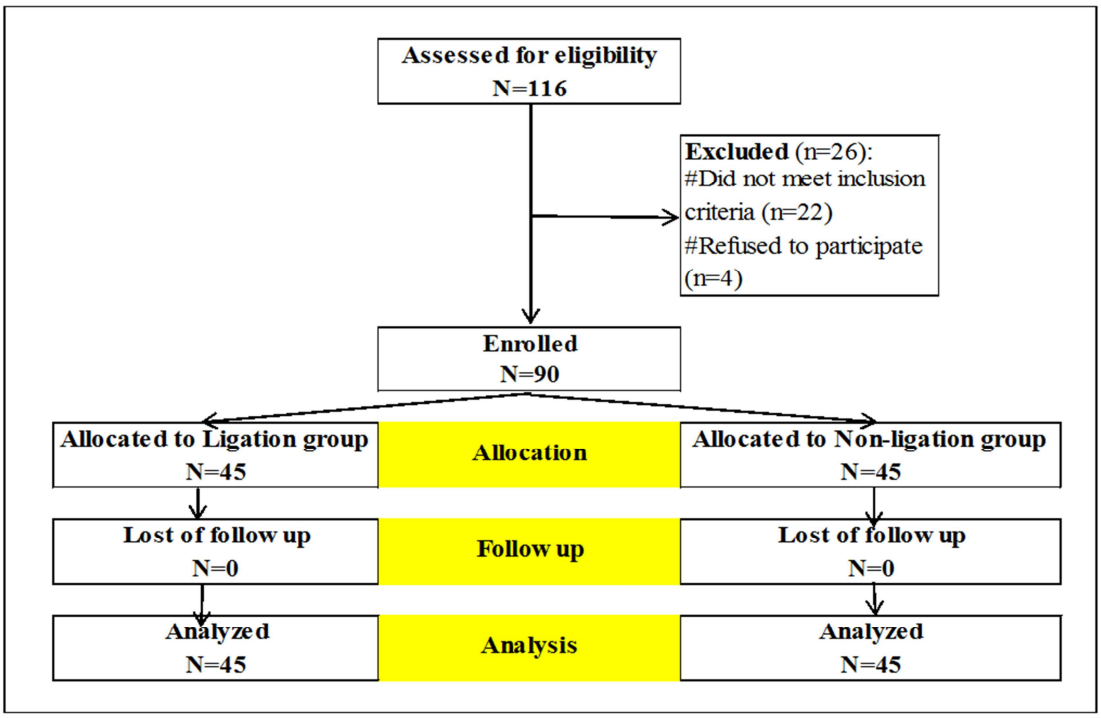

Figure 1. *Flow chart of the studied cases.*

Table 1. *Demographic characteristics among the studied groups.*

Items	Measure	Ligation (N=45)	Non-ligation (N=45)	P
Age (years)	Mean±SD	32.4±3.6	31.9±3.5	^0.561
	Range	25.0–42.0	25.0–40.0	
BMI (kg/m^2)	Mean±SD	27.5±0.8	27.6±0.9	^0.342
	Range	25.9–29.6	25.6–29.5	
Parity	Median (IQR)	3.0 (3.0–3.0)	3.0 (3.0–4.0)	§0.299
	Range	1.0–5.0	1.0–5.0	
GA (weeks)	Mean±SD	35.2±2.2	35.8±1.0	^0.119
	Range	24.0–37.0	31.0–38.0	

^Independent t-test. §Mann Whitney test.

No significant differences between the studied groups regarding demographic characteristics.

Table 2. *Hysterectomy duration (minutes) among the studied groups.*

Measures	Ligation (N=45)	Non-ligation (N=45)	^P
Mean±SD	195.1±33.4	176.2±48.4	0.034*
Range	155.0–350.0	100.0–330.0	
Impact of ligation			
Items	Mean±SE	95% CI	
Duration prolongation	18.9±8.8	1.5–36.4	

^Independent t-test, CI: Confidence interval, *Significant.

Table 2 show that: hysterectomy duration was significantly longer among ligation group than among non-ligation group.

Table 3. *Blood loss (mL) among the studied groups.*

Measures	Ligation (N=45)	Non-ligation (N=45)	^P
Mean±SD	1933.1±724.4	2117.2±668.5	0.214
Range	801.0–3283.0	867.0–3400.0	
Impact of ligation			
Items	Mean±SE	95% CI	
Blood loos reduction	184.1±146.9	-107.9–476.1	

^Independent t-test, CI: Confidence interval.

Table 3 show that: Blood loss was non-significantly lower among ligation group than among non-ligation group.

Table 4. *Hemoglobin (gm/dL) among the studied groups.*

Time	Measure	Ligation (N=45)	Non-ligation (N=45)	^P
Pre operative	Mean±SD	11.2±0.8	11.2±1.0	0.824
	Range	9.5–12.6	7.8–12.8	
Post operative	Mean±SD	8.6±1.5	8.0±1.4	0.052
	Range	5.4–11.9	3.0–10.2	
Reduction	Mean±SD	2.6±1.5	3.2±1.6	0.100
	Range	0.1–6.9	-1.5–6.4	
Impact of ligation				
Items		Mean±SE	95% CI	
Reduction decrease		0.6±0.3	-0.1–1.2	

^Independent t-test, CI: Confidence interval.

Table 4 show that: No significant difference between the studied groups regarding preoperative hemoglobin. Postoperative hemoglobin was non-significantly higher among ligation group. Hemoglobin reduction was non-significantly lower among ligation group.

Table 5. *Hematocrit (%) among the studied groups.*

Time	Measure	Ligation (N=45)	Non-ligation (N=45)	^P
Pre operative	Mean±SD	33.8±2.7	34.1±2.9	0.521
	Range	29.0–41.0	28.0–42.0	
Post operative	Mean±SD	26.1±5.0	24.5±4.3	0.101
	Range	16.0–38.0	17.0–34.0	
Reduction	Mean±SD	7.6±5.0	9.6±4.8	0.055
	Range	2.0–21.0	2.0–19.0	

Time	Measure	Ligation (N=45)	Non-ligation (N=45)	^P
Impact of ligation				
Items		Mean±SE	95% CI	
Reduction decrease		2.0±1.0	0.0–4.0	

^Independent t-test, CI: Confidence interval.

Table 5 show that: No significant difference between the studied groups regarding preoperative Hematocrit. Postoperative Hematocrit was non-significantly higher among ligation group. Hematocrit reduction was non-significantly lower among ligation group.

Table 6. *Blood transfusion among the studied groups.*

Findings	Ligation (N=45)	Non-ligation (N=45)	^P	RR (95% CI)
Required	35 (77.8%)	38 (84.4%)	0.419	0.92 (0.75–1.13)
Not required	10 (22.2%)	7 (15.6%)		

^Chi square test. RR: Relative rate. CI: Confidence interval.

Table 6 show that: Blood transfusion was non-significantly less frequent among ligation group.

Table 7. *Injuries among the studied groups.*

Site	Ligation (N=45)	Non-ligation (N=45)	P	RR (95% CI)
Bladder and ureter	5 (11.1%)	11 (24.4%)	^0.098	0.45 (0.17–1.20)
Intestinal	1 (2.2%)	2 (4.4%)	#1.000	0.50 (0.05–5.32)
Vascular	3 (6.7%)	0 (0.0%)	#0.242	--

^Chi square test. #Fisher's Exact test. RR: Relative rate. CI: Confidence interval.

Table 7 show that: No significant differences between the studied groups regarding Injuries.

4. Discussion

Cesarean hysterectomy is considered the main option for management of placenta accreta for more than a half of century since the first case was discovered. It had the advantage of reducing the immediate risks of major hemorrhage associated with accreta placentation [9].

Internal iliac artery ligation is one of the surgical options that may be done before cesarean hysterectomy in cases of placenta accreta [10].

Our study showed that internal iliac artery ligation during CS hysterectomy cases for AIP had a non-significant lower blood loss than cases who did not underwent internal iliac artery ligation. Instead, it had increased the operative time.

As regard the primary outcome, blood loss was non significantly lower in the group who underwent ligation with a mean of 1933 ml blood loss in comparison with 2117 ml in the group who did not.

In agreement with our study, *Khan et al.,* found that there is no role of internal iliac artery ligation in minimizing blood loss in cases of placenta percreta who underwent CS hysterectomy. They did not identify a statistically significant difference in the total EBL between the control and study group [6].

Also, according to Iwata et al. [8] ligation of the internal iliac artery did not sufficiently contribute to hemostasis during cesarean hysterectomy in cases of placenta previa accreta. This may be due to surgical difficulties, excess time consumption for the procedure and return of the blood flow from the external iliac artery collaterals [8].

Also, *Levine et al.,* showed that preoperative balloon occlusion of the internal iliac artery had no role in minimizing blood loss in cases of placenta accreta [11].

In a similar study, *Chen et al* included 114 cases of placenta accreta in their study. Internal Iliac artery balloon occlusion was done preoperatively for 83 out of the 114 cases with no significant effect on blood loss [12].

According to *Shrivastava et al,* 69 cases underwent CS hysterectomy, 19 of cases who had CS hysterectomy underwent preoperative balloon occlusion of the internal iliac arteries, and there was no difference in the blood loss in comparison with 50 patients who did not receive preoperative balloon occlusion [13].

Failure of internal iliac artery occlusion to decrease blood loss in cases of placenta accreta can be due to collaterals from the external iliac artery to pelvic circulation. This can be explain why common iliac artery temporary occlusion may have a beneficial effect [14].

According to *Papp et al,* Internal iliac artery ligation had quick control of pelvic hemorrhage and helped to preserve the uterus in 2 of 9 cases. It also decreased the incidence of relaparotomy [15].

El-sayed et al. [16] stated that either internal iliac artery ligation or balloon occlusion has an effective role in minimizing blood loss in cases of placenta accreta. Also, this decreases the need for hysterectomy. In this study, intraoperative bilateral internal iliac artery balloon occlusion was done for group of 50 patients and intraoperative bilateral internal iliac arteries ligation was performed for another group of 50 patients before any attempt to remove the abnormally adherent placenta. Both techniques seemed to have equal effect in minimizing the demand for hysterectomy with higher rate of bladder and ureteric injuries in the ligation

group. The amount of blood loss in internal iliac artery balloon occlusion group is less than that with the internal iliac artery ligation group [16].

Also *Refaie et al.* showed that prophylactic bilateral internal iliac artery ligation before extraction of placenta accreta was an effective method to decrease cesarean section complications and avoid emergency hysterectomy [17].

Carnevale et al. [18] found that internal iliac artery balloon occlusion decreased intraoperative blood loss and transfusion requirements when comparing the patients retrospectively with a control group.

Balloon occlusion has the advantage of being reversible after the procedure in comparison with the intraoperative internal iliac arteries ligation [18].

A major benefit of intraoperative internal iliac artery ligation over intraoperative balloon occlusion is prevention of fetal exposure to radiation, save time and team works as interventional radiologist. Also, catheter related complications occur in about 7% of patients including; complications of angiography, pelvic infection, a self-limited pyrexia, and maternal thromboembolic events [16].

Madhubala found that among 31 cases of placenta previa enrolled in his study, bilateral internal iliac artery ligation in both elective and emergency cases had a good effect in minimizing blood loss and decreasing the need for peripartum hysterectomy [19].

One possible limitation in our study may lie in the size of our study groups, another limitation was the lack of randomization and despite the non-significant difference in the demographic data of the two arms, selection bias can not be ruled out with certainty.

Further randomized studies with larger number of patients should be done in this field. Also, trials to have alternative way for internal iliac artery occlusion such as balloon tamponade.

5. Conclusion

Bilateral internal iliac artery ligation, in cases of AIP undergoing caesarean hysterectomy, is not recommended for routine practice to minimize blood loss intraoperatively.

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