

# Clinical spectrum of internal iliac artery ligation in obstetrics and gynecology

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## ABSTRACT

**Objective:** To study the role and efficacy of internal iliac artery ligation (IIL) in obstetrics and gynaecology practice. **Methods:** Retrospective review of detailed clinical data of 89 women who underwent emergency or elective IIL from January 2009 to December 2019 for any obstetrical or gynaecological indication at Shri Guru Ram Rai Institute of medical and health sciences, Dehradun, Uttarakhand. **Results:** Among 89 cases, 76 were done for obstetrical and 13 for gynaecological indication. Morbidly adherent placenta and uterine atony were the main indications for IIL in obstetrics while radical hysterectomy in gynaecological cases. Our study shows a statistically significant ( $P$  value  $<0.005$ ) correlation in the need for blood transfusion between elective versus emergency IIL. Among 76 cases done for obstetrical indication, in 65.8% of cases uterus was saved emphasizing the importance of IIL. **Conclusion:** IIL is a safe, rapid and effective method of controlling pelvic haemorrhage during any emergency or elective pelvic surgery and it also prevents unnecessary hysterectomy in many obstetrical indications.

**Keywords:** Internal iliac artery ligation, morbid adherent placenta, postpartum haemorrhage, hysterectomy.

Internal iliac artery ligation is one of the important methods of controlling pelvic haemorrhage. The procedure was performed for the first time by Sir Horward Kellys in 1893 to control haemorrhage during hysterectomy for uterine carcinoma.

The procedure was later introduced by Magnert WF et al and extensively investigated by Burchell RC in 1968.<sup>1,2</sup> The main indications of the procedure in gynaecology include carcinoma of the cervix, any pelvic surgery with uncontrollable haemorrhage. In obstetrics, massive bleeding due to atonic or traumatic post-partum haemorrhage, adherent placenta, broad ligament hematoma and rupture uterus are the main indications.

The present study is done to share the author's experience regarding the usefulness and safety of internal iliac artery ligation in the control of intractable pelvic haemorrhage in obstetrics and gynaecology.

## **Materials and methods**

This retrospective study was carried out from January 2009 to December 2019 in Shri Guru Ram Rai Institute of medical and health sciences, Dehradun, Uttarakhand state of India which is a tertiary care centre for high risk obstetrics and major gynaecological surgeries. All the cases were performed by a senior obstetrician (principal author) as the majority of cases were referred in critical condition or major difficult obstetrical and gynaecological cases were done under her supervision for performing bilateral IIL as and when required. The patients were identified using operating theatre registers and record office resources.

Detailed data analysis was done in relation to socio-demographic profiles of patients, indications for IIL in obstetrics and gynaecology, emergency and elective nature of the operation, preoperative and postoperative haemoglobin, intraoperative and post-operative number of

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blood transfusions, duration of hospital stay, the need of ventilator support, associated morbidity and mortality and future fertility after the procedure.

The collected data was entered in MS Excel for data analysis. For data analysis statistical test, Student's test was used and a p-value < 0.05 was taken as statistically significant.

A standard ligation procedure was performed in all cases. The ligation of the internal iliac artery is technically simple, safe and rapid, only if the pelvic anatomy is clear in detail.

**Anatomical consideration:** Internal iliac or hypogastric artery arises at the bifurcation of the common iliac arteries on either side at the level of the lumbosacral intervertebral disc and in front of sacroiliac joints, from where it descends to the upper margin of the greater sciatic foramen for 3-4 cm where it divides into an anterior trunk which continues in line with the parent vessel towards the ischial spine and the posterior trunk which passes backwards towards the foramen. As retroperitoneal arteries are in direct relationship to the ureters and large iliac veins. The ureter crosses over the internal iliac artery anteriorly from lateral to medial where the artery arises from the bifurcation of the common iliac artery. The large external and internal iliac veins are posterolateral and posteromedial, respectively, to the internal iliac artery.<sup>3</sup>

**Surgical technique:** Peritoneum on the lateral side of common iliac artery is vertically opened in such a way that the ureter remains attached to the medial fold of peritoneal reflection. The internal iliac artery is traced downwards by gentle dissection of the fascia over the artery. A double thread of non-absorbable suture is passed beneath the artery with the help of mixer forceps from the lateral to the medial side which is safer than the medial to the lateral side having more chances of injury to the iliac vein. The first suture is tied firmly but gently at a level below the origin of the posterior branch of the internal iliac artery. The second suture is tied below the first to avoid postoperative recanalisation. Transfixation or division of the artery in between the two sutures is not required. The femoral artery is palpated for pulsations and perfect homeostasis is secured. If the bleeding is not controlled decision for hysterectomy is taken. Repair of the ruptured uterus, colporrhexis and vaginal lacerations was done after IIAL.

The injuries that can occur to the iliac veins during this procedure may be due to perforation either by hemostat during dissection of fascia around the internal iliac artery or by the tip of the right-angled clamp that is passed beneath the

internal iliac artery. These venous perforations can be located with the use of good illumination using a fiberoptic light source and suction. These perforations can be sealed by passing a figure of 8 sutures around the defect in the vein with 3-0 silk and then incorporating adventitia of the internal iliac artery to support the injured vein.

**Hemodynamic consideration:** The main underlying principle in ligation of the internal iliac artery for control of pelvic haemorrhage is the conversion of arterial pressure circulation into venous pressure circulation. Unilateral ligation of the internal iliac artery, decreases the pulse pressure distal to point of ligation by 77%, while bilateral ligation decreases the pulse pressure by 85%.<sup>4</sup> As a result of the reduction in the pulse pressure, blood clots begin to form at the site of bleeding from the damaged vessels. Thereby transforming the pelvic artery into a venous-like system with minimal blood flow. The sluggish blood flow at a slow rate prevents blood loss.<sup>5,6</sup>

Blood supply to the pelvis continues via extensive collateral circulation with the aorta and the femoral artery including the lumbar, iliolumbar, middle sacral, lateral sacral, superior and middle hemorrhoidal, and gluteal arteries. Collateral circulation becomes functional as early as 45-60 minutes after ligation.

Some of the reported complications are accidental injury to iliac veins and ureters, necrosis of the perineum, buttocks and severe blood loss. Although effective in majority of cases, sometimes there is the failure of the arrest of haemorrhage following the procedure. Possible reasons are the presence of large aberrant branches feeding blood to the area, dislodgement of clots when blood pressure rise, concomitant severe venous bleeding, or massive necrosis after infection with the destruction of vessels.

## Results

IIAL was performed on 89 women during the study period. Out of which 76 were done for obstetrical indication and 13 were done for gynaecology conditions (table 1). In obstetrical indications, a maximum number of IIAL were done for uterine atony (31.6%) followed by the morbidly adherent placenta (23.7%). In gynaecological indications, 46.2% of IIAL were done as a prophylactic procedure during radical hysterectomy, and 30.7% were done during difficult gynecological surgeries with dense adhesions and excessive intraoperative haemorrhage occurred during the surgery and 23.1% of IIAL were done as an emergency life-saving procedure after postoperative haemorrhage.

Table 2 describes the socio-demographic and clinical profile of 76 patients in which IIAL was done for obstetrical

**Table 1: Indications for IIAL (n=89)**

Indications	No. of women	Percentage
Obstetrical	76	85.4
Uterine atony	24	31.6
Placenta Previa	11	14.5
Morbidly adherent placenta	18	23.7
Placental abruption	7	9.2
Coagulopathy	6	7.9
Intra-caesarean extensions	1	1.3
Uterine rupture	5	6.6
Lower genital tract injury	2	2.6
Broad ligament hematoma	2	2.6
Gynecological	13	14.6
Radical Hysterectomy	6	46.2
Post Hysterectomy hemorrhage	3	23.1
Difficult gynaecological surgeries with dense adhesions and massive intraoperative bleeding	4	30.7

indications. Out of these 76 cases, 61.8% cases were referred cases and 30.3% of cases have a history of previous uterine surgery.

**Table 2: Socio-demographic and clinical characteristics of obstetrical cases (N=76)**

Characteristics	Mean ± SD (range)
Age (years)	26.48±8.17 (22yrs – 37yrs)
Rural (no)	52 (68.4%)
Gravidity	2.02±1.46 (0 – 6)
Parity	1.82±1.08 (0 – 6)
No. of abortions	1.02±0.22
No. of living children	1.01±0.54
History of previous uterine surgery (no)	23 (30.3%)
Referred cases (no)	47 (61.8%)

Table 3 shows the need for blood transfusions and the nature of IIAL done as an emergency or elective procedure. Among gynecological cases (13), 53.8% of cases were done as elective and 28.6% of these received blood transfusions and 46.2% cases were done as emergency IIAL and 100% of these patients required transfusions which shows a significant (p<0.05) correlation. Among 76 obstetrical cases, 60.5% were emergency and 39.5% cases were elective. All(100%) cases done in an emergency required blood transfusion and 73.3% of cases done as the elective procedure required transfusions which shows a significant (p<0.05) correlation.

**Table 3: Need for blood transfusion in emergency and elective BIIAL**

BIIAL surgery	Obstetrics (n=76)	No blood transfusion	Received BT	P-value	S/NS
Emergency	46(60.5%)	0 (0%)	46(100%)	0.0003	S
Elective	30(39.5%)	8 (26.7%)	22(73.3%)		
Gynaecology (N=13)					
Emergency	6(46.2%)	0 (0%)	6 (100%)	0.0210	S
Elective	7(53.8%)	5(71.4%)	2(28.6%)		

BIIAL – Bilateral internal iliac artery ligation, S – Significant, NS - Nonsignificant

Table 4 depicts the uterine salvage rate in obstetrical cases. Among 76 cases, in 65.8% of cases uterus was saved

and 34.2% of cases required hysterectomy despite IIAL. The majority of hysterectomies (50%) were done in morbidly adherent placenta condition and 38.5% were done for uterine atony which came as referred cases and usually has 5hrs to 8hrs of delay and came in shock and superimposed DIC. IIAL done in cases of coagulopathy also had a hysterectomy as the last life-saving procedure.

**Table 4: Uterine salvage rate in the obstetrical case according to indication**

Indications	No. of women	Hysterectomy	Uterine salvage	Percentage of uterine salvage
Obstetrical	N=76	N=26(34.2%)	N=50	65.8
Uterine atony	24	5	19	79.2
Placenta previa	11	2	9	81.8
Morbidly adherent placenta	18	13	5	27.8
Placental abruption	7	1	6	85.8
Coagulopathy	6	3	3	50.0
Intracaesarean extensions	1	0	1	100
Uterine rupture	5	2	3	60.0
Lower genital tract injury	2	0	2	100
Broad ligament hematoma	2	0	2	100

Table 5 shows the relationship between the time interval lapsed before IIAL and the difference in patient outcomes in obstetrical cases. During caesarean section 47 patients required IIAL and 7 patients needed ventilator support and no mortality occurred. Atonic PPH following vaginal delivery, 14 cases were done 4 required ventilator support and 5 mortality occurred, but these were all cases received after prolonged time (1.5±18.6hrs) due to referral from remote hilly region. One mortality was documented in uterine rupture and one after coagulopathy. The time interval between the onset of haemorrhage and IIAL affected the need for blood transfusion and the outcome of the patients. Among 13 cases of gynaecology only one required ventilator support and no mortality occurred.

Table 6 shows the outcome in referred cases according to the time lapsed before IIAL. All patients who were referred during the antenatal period whenever morbidly adherent placenta was suspected or diagnosed have no mortality. Among the total of 7 mortality, 5 were referred cases which shows that delay in IIAL defeats the life-saving purpose as the patient already goes into irreversible shock.

During IIAL, there were no procedural complications which may be due to the fact that all cases were done by an experienced and single surgeon. There were no ischemic complications such as gluteal muscle ischemia or bladder ischemia seen in post-operative short and long time follow-up visits.

**Table 5: Timing of IIAL and patient outcome**

Time of haemorrhage	Total no. of patients	Time interval before IIAL Mean ± SD	Units of blood transfused	Units of FFP transfused	No. of patient needing ventilator support	Mortality
At caesarean section	47	1.01±0.62	2.44±1.56	3.42±1.45	7	None
Atonic PPH after vaginal delivery	14	1.5±18.6	4.34±0.28	8.84±2.23	4	5
Broad ligament hematoma	2	2.13±0.66	4.43±1.24	3.15±1.52	None	None
Lower genital tract injury (traumatic PPH)	2	2.04±0.45	3.53±1.54	2.43±2.2	1	None
Uterine rupture	5	1.8±0.54	3.84±1.56	4.43±1.56	2	1
Coagulopathy	6	3.08±0.76	8.95±2.54	16.4±4.45	4	1
Gynecological cases	13	1.02±0.5	4.12±1.62	2.33±1.68	1	None

Among 50 patients whose uteri were saved, all patients resumed menstrual functions within 7 months of IIAL. Out of these 50 women, 28 patients tried for the next pregnancy and 11 patients (39.3%) had documented live pregnancy but the rest of 17 patients were lost to follow-up.

the external iliac, and inferior epigastric and inferior mesenteric arteries were seen in the morbid adherent placenta causing failure of arresting haemorrhage even after IIAL ligation. Reperfusion of the internal iliac artery distal to the ligation site occurred due to the inflow of anastomotic

**Table 6: Referred cases and outcome (N=47)**

Indications	Total no. of cases	Time of referral	Time-lapse before IIAL	Uterine salvage	Mortality
Morbidly adherent placenta	13	Antenatal period	0	2	None
Atonic PPH following vaginal delivery	8	0.5-26hrs	1.2hr-28hrs	3	3
Uterine rupture	4	1.0-12hrs	0.5-16hrs	3	1
Relaprotomy after caesarean and /or coagulopathy	5	1.5-24hrs	1.8-26hrs	2	1

**Discussion**

All obstetricians caring for maternal morbidity and mortality should familiarize themselves with IIAL procedure and lower their threshold for using it in an emergency. IIAL not only contributes to the prevention of hysterectomy but also in cases where hysterectomy cannot be prevented, it facilitates the hysterectomy as in cases of uterine trauma.<sup>7</sup> IIAL decreases the bleeding, and clears the operative field thus decreasing the chances of the ureter and other pelvic viscera injuries. IIAL also facilitates the repair of vaginal lacerations that bleed profusely.

Since the morbidity of IIAL in experienced hands is less, so concurrent prophylactic IIAL may be life-saving during caesarean section with high risk for PPH like placenta previa, placenta abruption, diagnosed or suspected cases of the morbidly adherent placenta, HELLP syndrome, ITP and any other causes of coagulation disorder.

The reported success rate of IIAL varies from 40 to 100%, but the procedure averts hysterectomy in only 50% of cases.<sup>8</sup> The failure of this technique to reduce blood loss is attributed to the associated technical difficulties and excess time consumption required to block blood flow. Other cause is blood flow in the branches of the external iliac artery ascending from the perivesical area and in the vagina is so plentiful in cases of placenta increta or percreta, ligation of the internal iliac artery might be ineffective for arresting haemorrhage from the vaginal stump or the adhered bladder area. Sometimes extensive anastomotic communication with

blood resulting from the development of the collateral blood supply from the rectal branch of inferior mesenteric artery, superior gluteal artery and inferior epigastric artery. These results suggested the necessity of simultaneously blocking blood flow in both internal and external iliac arteries.

Balloon occlusion of the internal iliac artery is a recent adjuvant haemostatic procedure that has varied results in different studies. Selective arterial embolization can be used as an option in managing haemorrhage if the woman is hemodynamically stable. Main indications include haemorrhage due to vaginal or cervical lacerations or persistent bleeding after hysterectomy. Due to the above-mentioned reasons, balloon occlusion of the common iliac artery or aorta may be an alternative perinatal management strategy to reduce haemorrhage. Availability of interventional radiologists with required infrastructure in developing countries always comes in the way.

Angiographic selective arterial embolization (UAE) is a safe and effective method of controlling severe PPH in 90% to 95% of cases irrespective of the cause of PPH.<sup>9,10</sup> The advantages of UAE are a preservation of the uterus and fertility, avoidance of laparotomy, and technically difficult hysterectomy.

Some study states, that if facilities of uterine artery ligation and UAE are available in a hemodynamically stable patient, the first choice would be embolization as the procedure has a higher success rate (>90%) compared with hypogastric artery ligation (40% to 75%), and finally, if embolization fails, hysterectomy can still be performed.<sup>11,12</sup>

Prophylactic IIAL to reduce blood loss has been used with favourable outcomes in radical procedures like Wertheim's hysterectomy, radical vulvectomy, and abdominoperineal resection of carcinoma of the rectum.<sup>13</sup> In these cases bilateral IIAL was performed as the first step which makes the operative field bloodless during the dissection of the ureteric tunnel and lymph nodes with no added short or long-term complications related to the procedure.

However, even when the uterus is preserved, ligation of these arteries does not hamper future reproductive function. Wagaarachchi and Fernando observed future pregnancy in 50% of the cases following bilateral IIAL.<sup>14</sup> In the present study we analyzed 76 Obstetric cases of IIAL with a uterine salvage rate of 65.8%. AK Nayak et al<sup>15</sup> had analyzed 45 cases over 2 years with a uterine salvage rate of 73.4%. Mukherjee et al<sup>16</sup> performed 36 cases of IIAL with a success rate of 83.3% in 6 yrs and Joshi et al<sup>7</sup> did a study on 110 women who had undergone bilateral IIAL over 13 years with a uterine salvage rate of 60.7%.

A study done by J Du Bose et al<sup>17</sup> on twenty-eight hemodynamically unstable patients with pelvic fracture and expanding retroperitoneal hematoma emphasized the role of bilateral IIAL as a damage control tool potentially useful for a selected group of patients with massive retroperitoneal haemorrhage after pelvic fracture.

The major cause of the failure of IIAL is a delay, when the hemorrhagic shock is irreversible, this operation will not overcome it. Inadequate transfusion is another pitfall in the therapy of patients with severe haemorrhage as blood loss is often underestimated.

#### Conclusion

IIAL is a more conservative procedure than obstetrical hysterectomy in young women with low parity with intractable pelvic haemorrhage. It is associated with lesser morbidity and preserves the chance of future fertility. In low-resource settings where newer techniques are not available, IIAL still plays a crucial role to save the uterus and life of women.

**Conflict of interest:** None. **Disclaimer:** Nil.

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