

Internal iliac artery ligation – time to revive a dying art

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'You cannot save the world, but you might save the woman in front of you if you act fast and diligently'

Introduction

Before internal iliac artery ligation (IIAL) was considered a feasible approach to the problem of pelvic haemorrhage, blood, time and lives were lost. The procedure has saved numerous lives ever since it was widely used as a means of controlling intractable pelvic haemorrhage. Ligation of internal iliac arteries has stood the test of time as a safe and effective means of controlling life threatening pelvic haemorrhage without compromising the rest of the pelvic blood supply.

Historical background

Peripartum hysterectomy, or removal of the uterus around the time of delivery, was first proposed as a means of saving lives of women who bled profusely following childbirth, by Joseph Cavallini as way back in 1768, based on experiments performed on animal models. The first caesarean hysterectomy was performed 100 years later in 1869 by the American physician, Horatio Storer. However, his heroics could

not save the woman. The first successful case of peripartum hysterectomy in which both the woman and baby survived was performed by the Italian obstetrician, Eduardo Porro in 1876. He managed to achieve haemostasis by passing a constricting wire around the cervix, and for a long time afterwards, the procedure was termed 'Porro's operation'. Various modifications to the technique followed in the years afterwards and hysterectomy remained the sole method of controlling life threatening haemorrhage following childbirth in the past. However, its impact on fertility of women who desired to bear children in the future could not be reversed.

Internal iliac artery ligation or simply cutting off the major supply line to the pelvis, emerged as an effective alternative to peripartum hysterectomy to control massive postpartum haemorrhage (PPH), in women who desired subsequent fertility. The advent of IIAL is not entirely clear. Unilateral ligation had been performed in 1812 in a case of gluteal aneurysm. The procedure came into the limelight in the field of obstetrics and gynaecology when Sir Howard Kelly performed ligation of the internal iliac arteries in order to control intractable haemorrhage during an operation

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for cervical cancer in 1893. However, it was not until R Clay Burchell in the late 1960s alleviated the fears among the surgeons by proving that the procedure did not entirely shut the blood supply from the pelvis, when the procedure of IIAL began to emerge as a useful tool in the management of PPH.

Physiology of internal iliac artery ligation

The internal iliac arteries supply all the pelvic organs – uterus, vagina, urinary bladder, rectum and anal canal with extensive collateral circulations among these viscera. As a result of extensive collateral circulations in the pelvis, ligation of internal iliac arteries even on both sides does not shut the blood supply to the pelvis completely. Therefore, one can ligate both the internal iliac arteries without fear of ischaemic necrosis of these pelvic viscera. However, at the same time, as a result of these extensive collateral circulations, ligation of the internal iliac arteries fails to arrest bleeding from the pelvis completely. This is evident in cases of placenta praevia accreta in which marked collateral circulations develop within the pelvis. In addition, it is essential in most cases that internal iliac arteries on both sides are ligated in order to achieve haemostasis. Unilateral ligation can only be successful in controlling bleeding in limited situations such as bleeding from the pelvic side wall.

The effect of ligating the internal iliac arteries is the near abolition of the arterial pulse pressure, the result being change from an arterial system to a circulation similar to that of a venous system, with slow and sluggish blood flow and virtual elimination of the ‘trip hammer effect’ of the arterial pulsations. This gives the normal clotting mechanisms of the body an opportunity to achieve haemostasis.

Indications for internal iliac artery ligation

The desire to preserve fertility and the fact that, in certain situations, even hysterectomy fails to control the haemorrhage, have led to the discovery of alternatives to hysterectomy, of which IIAL is one. Internal iliac artery ligation has been extensively used in the past to manage haemorrhage due to uterine atony refractory to medical treatment, genital tract trauma, placenta praevia, placenta accreta and following abortion.

It is invaluable as a means of arresting blood loss in cases of deep forniceal tears and haematomas extending in to the broad ligament. It is precious as a measure of containing troublesome bleeding from areas of diffuse bleeding within the pelvis without a clearly identifiable vascular bed. In these instances, uterine artery ligation or even hysterectomy does not arrest bleeding. Even following hysterectomy, IIAL reduces the risk of reactionary haemorrhage, and instills confidence in the mind of the surgeon, thereby obviating the chances of the patient returning to the operating theatre.

In complete placenta praevia, as the lower segment of the uterus receives a considerable proportion of its blood supply from the descending cervical and vaginal arteries, even if one were to adopt a conservative approach, IIAL is far more effective than uterine artery ligation in controlling haemorrhage as the blood supply from both the uterine and vaginal arteries is reduced following IIAL.

Uterus preserving options have emerged recently in the management of morbidly adhered or invaded placentae. However, an emergency obstetric hysterectomy and ligation of the internal iliac arteries on both sides performed in double quick time, is the most rational and probably the only option in the face of torrential bleeding, which threatens to take away the life of the woman within seconds. The necessity to perform IIAL can only be expected to rise in the future due to the escalating rates of caesarean delivery with its concomitant increase in the incidences of placenta praevia and accreta, potentially lethal conditions associated with caesarean delivery.

Internal iliac artery ligation – under threat of being defunct?

The introduction of numerous uterotonic agents for the management of uterine atony such as misoprostol, the antifibrinolytic agent, tranexamic acid and relatively less-invasive techniques such as balloon tamponade of the uterus, compression sutures on the uterus and pelvic arterial embolization have sidelined this invaluable technique. The biggest competitor is pelvic arterial embolization, which has pushed IIAL almost to the brink of being defunct in our speciality.

One may believe IIAL is a thing of the past, with many women with the potential to bleed being managed with

pelvic arterial embolization especially in developed countries. However, one may not realize that the general maternity unit is far from being equipped with the infrastructure or being blessed with the resources to perform pelvic arterial embolization, the alternative to IIAL. Even in the best of maternity centres, when having to deal with unanticipated bleeding, during which it is practically impossible to arrange the equipment or the expertise needed for interventional radiology, it is the IIAL that will come to one's rescue. Uterine artery embolization is not without complications. Post-procedure fever, intrauterine synechiae, bladder necrosis, and uterine necrosis and have resulted following uterine artery embolization. These complications may arise because the tiny particles used in the embolization process may also get lodged in the collaterals which are expected to maintain the blood supply to the pelvis after the intervention, thus leading to a compromised blood circulation within the pelvis. These complications are almost unheard of following IIAL.

Today, the toughest opponent that IIAL has been forced to fight against, is none other than one's hesitancy to perform the manoeuvre when required. Inadequate exposure of trainees to the technique, lack of confidence in performing the manoeuvre and fear of complications have resulted in one having to call upon vascular surgeons or even denial of this life saving procedure during instances in which ligation of the internal iliac arteries is required. The skill of performing IIAL is an essential one especially in resource-depleted settings with no or limited access to interventional radiology and when having to face unanticipated bleeding even in the most well-equipped maternity centres anywhere in the world. Therefore, it is essential that every obstetrician is familiar with the technique of IIAL, a life-saver, which might come in handy at any moment of time.

My study

The oration is based on a series of 43 cases of bilateral IIAL which I performed in the course of management of PPH during a period of 10 years from 2009 up to 2019 at the North Colombo Teaching Hospital and two private hospitals in Ragama, Sri Lanka. A retrospective analysis was performed by going through the patients' notes whenever they were available and also by interviewing and going through their diagnosis cards.

The outcome with regard to the need for blood transfusion both intra-operatively and post-operatively, admissions to the intensive care unit, hospital stay following the procedure were assessed. These women were followed up at a variable time period between 3 months to 10 years following the procedure and the functions relevant to the pelvic organs such as reproductive, sexual, bladder, and bowel, assessed.

In close to half the cases, 20 out of 43, IIAL was performed as an adjunct to hysterectomy. The most notable contributor in this group was uterine atony with 9 cases. This was especially at a time during which misoprostol and tranexamic acid were not automatic choices in the management of PPH. This was followed by 6 cases of placenta accreta, in fact placenta increta or percreta, out of which 4 were performed at the time of caesarean hysterectomy, and 2 were performed when these two women with placenta percreta who had been managed conservatively presented later with vaginal bleeding. There were also 3 cases of major degree placenta praevia and 2 cases of uterine rupture in this group.

In a little over half the cases, IIAL was successful in saving the uteri. The most notable contributor in this group was placenta praevia with 12 cases, followed by 6 cases of uterine atony, 4 cases of placenta accreta, and 1 case of 'Couvellaire uterus' following placental abruption.

Procedure of internal iliac artery ligation

General considerations

The abdominal cavity was entered via a suprapubic transverse incision in almost all cases except in 3, on whom there was a midline scar already. Placental mapping had been done in all cases of placenta praevia and accreta. Lower segment caesarean delivery was performed in these cases. However, the uterine incisions were made at a slightly higher level than normal in order to avoid encroaching in to the placenta at caesarean delivery.

A head down tilt was utilised, uterus exteriorized, and the abdominal viscera including the sigmoid colon packed above the sacral promontory in order to gain access to the pelvic side wall as well as to reduce uterine bleeding.

Approach to the internal iliac artery

Out of the two approaches to the internal iliac artery that an obstetrician and gynaecologist would usually take, the direct or the broad ligament, mainly the direct approach was used in my study except in 11 cases on whom hysterectomy preceded IIAL and the broad ligament was already open.

The extraperitoneal approach which is via a skin incision on the inguinal area and a muscle-splitting incision on the external oblique muscle referred to as the Rutherford-Morrison technique, is almost exclusively adopted by surgeons, both vascular and trauma.

There are a lot of anatomical variations among the branches of the internal iliac artery, but remarkably the anatomy is relatively constant within the first 2-3 cm of the vessel, the site of relevance as far as ligation is concerned.

The technique of internal iliac artery ligation – an art

The technique of IIAL has been handed over from one generation of obstetricians to another and a meticulous surgical technique is critical in ensuring both the safety as well as the effectiveness of the procedure. The bifurcation of the common iliac artery is identified using the sacral promontory as a guide. The peritoneum on the pelvic side wall is opened 2 cm below the bifurcation of the common iliac artery just lateral to the ureter, in case the direct approach is adopted. The loose areolar tissue is cleared, in the direction of the blood vessels in order to avoid damage to these vessels, until the bifurcation of the common iliac artery comes in to view.

The bifurcation of the common iliac artery stands out as an inverted Y, with the common iliac artery continuing as the external iliac artery which courses laterally and upwards and the internal iliac artery branching off at a right angle to the common iliac artery and coursing medially and downwards. Identification of this inverted Y is of utmost importance because in a stressful and demanding situation as in the case of a difficult PPH, this would ensure that one does not accidentally ligate the common iliac, external iliac arteries or for that matter even the ureter.

Whatever approach to the internal iliac artery is taken, the ureter is taken into the medial fold of peritoneum

and retracted with the use of Kelly retractors, yet another gift to the speciality from Sir Howard Kelly. This helps gravity take effect in deviating the ureter away from the surgical site, enabling one to perform surgery easier and also avoiding damage to the ureter. Kelly retractors are used not only to retract the peritoneal flaps but also to apply slight pressure on the blood vessels in cranial and caudal directions, because a stern (as opposed to lax) blood vessel makes it easier to clear the loose areolar tissue off the vessel.

Then the loose fibroareolar tissue around the internal iliac artery is cleared until a clear plane is identified between the internal iliac artery and vein, the most precarious part of the surgery. One may use dental cottons mounted on Allis forceps for this purpose. Usage of a fine right angled forcep (e.g. Mixter) is also recommended for this purpose. If a fine right angled forceps is used to separate the loose areolar tissue around and underneath the internal iliac artery, one should place the forcep just at the lateral and inferior borders of the artery and carefully clear the tissues by gently opening its tips. At no time, should the forcep be forcefully or blindly introduced between the artery and the vein.

Once a clear plane has been identified, the fine right angled forcep is passed from the lateral to medial side beneath the internal iliac artery (Figure 1). Passing the fine right angled forcep from the lateral to medial side avoids damaging the external iliac vein which lies lateral to the internal iliac artery. This is done about 2-3 cm from the origin of internal iliac artery which would avoid incorporation of its posterior division in to the ligature. The posterior division is given off just distal to the origin of the internal iliac artery. Incorporation of the posterior division of the internal iliac artery in the ligature would lead to ischaemia of the gluteal region thus causing pain and even necrosis of the buttocks. Tracing the branches of the internal iliac artery, and for that matter even its posterior division is not necessary and could even be dangerous as it can cause injury to the blood vessels.

Next comes the feeding of the suture on to the fine right angled forcep underneath the vessel. An assistant should get a doubled No. 0 or 1.0 absorbable suture on a second fine right angled forcep and feed the suture on to the fine right angled forcep which is underneath the artery from below. The suture is caught with the

fine right angled forcep underneath the vessel while avoiding excessive swaying of the instruments (Figure 2). The loop of the suture is cut and one is in possession of two sutures underneath the internal iliac artery. The anterior division of the internal iliac artery is then doubly ligated with sutures 5 mm apart, but not divided. Complete division of the internal iliac artery is not necessary and could even be dangerous as it may cause damage to the underlying internal iliac vein.

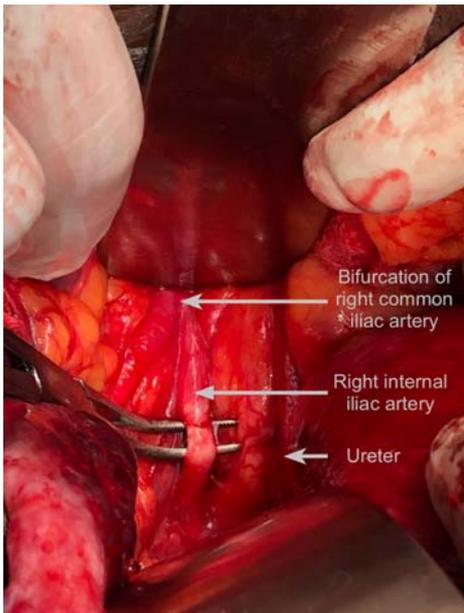


Figure 1. **Introducing the fine right angled forcep underneath the internal iliac artery.**

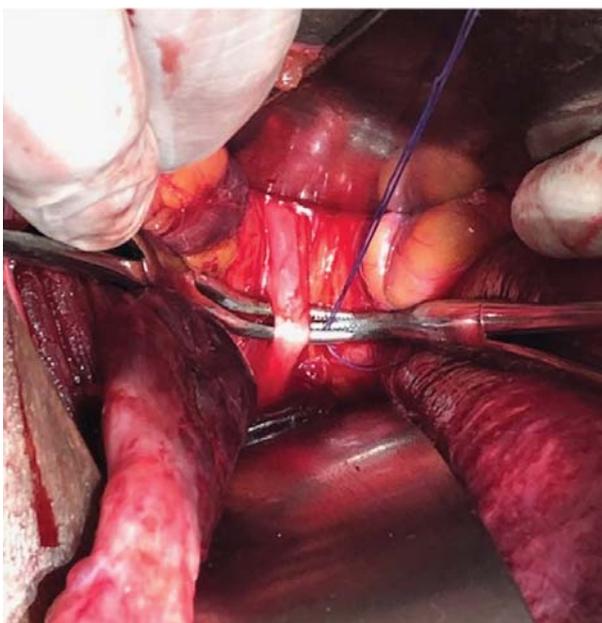


Figure 2. **Feeding of the suture for ligation.**

One should ensure that the external iliac artery is intact by placing a saturation probe on the toes of the lower limb as accidental ligation of the external iliac artery would lead to ischaemia of the lower limb, thus risking loss of that limb. The procedure is repeated on the other side. Ligation of the internal iliac arteries is not just a sequence of surgical steps, but an art. This is an operation which takes only a few minutes to perform, but one which can stand between life and death of the woman.

Complications

The commonest serious complication of the procedure which is reported in the literature is damage to internal iliac veins. Inadvertent ligation of the common iliac or external iliac arteries, involvement of the posterior division of the internal iliac artery in the ligature and damage to the ureters are rare complications. None of these complications were encountered in my study. These complications were avoided by giving careful consideration to the anatomical relationships of the iliac vessels and by the meticulous surgical technique described above. There was one case of damage to the internal iliac artery itself before the ligation was completed, which was easily managed by applying clamps on either side of the injury and tying the vessel. During instances in which the procedure of IIAL was performed with assistants and nurses who were unfamiliar with the technique, the process of feeding the suture was rehearsed beforehand in order to ensure smooth surgery as well as to ensure that too much time was not spent in performing the manoeuvre, because in bleeding, every second is precious.

Outcome

All the women in my series made an uneventful recovery following the procedure. The procedure of IIAL probably played a pivotal role of saving lives in at least some of these women. There were 11 admissions to the intensive care unit following the procedure, the reason being the condition that led to the procedure of IIAL to be performed, that is PPH, rather than the procedure itself. The average hospital stay following the procedure was 5.6 days. It was apparent that the procedure reduced the need for blood transfusion both intra-operatively and post-operatively, admissions to the intensive care unit, and also post-operative hospital

stay. The findings are consistent with the findings of a study done on a cohort of this series, 7 women with suspected placenta praevia or accreta on whom IIAL was also performed, during the period from August 2018 to February 2019.

Lack of a control group meant that direct comparisons of the effects of the intervention or otherwise were not feasible. Direct comparisons probably will never be possible because the procedure of IIAL is performed at the most impractical time to randomise any woman to any intervention, the moment of bleeding, the moment during which she is fighting for her life and we are fighting to save her.

Long term follow up

The procedure of IIAL emerged as a means of controlling life threatening haemorrhage following childbirth in women who desired subsequent fertility. However, there have been and still are concerns about whether this procedure affects fertility and also whether this procedure leads to ischaemia of pelvic viscera. Data from follow up of women in my study suggests that the ligation of the internal iliac arteries does not cause any dysfunction as far as reproductive, sexual, bladder, and bowel functions are concerned. No one complained of any symptoms suggestive of ischaemia of pelvic viscera, neither did anyone complain of symptoms suggestive of ischaemia of the gluteal region.

Three women turned up pregnant again following the procedure. These numbers may not sound phenomenal. This could be due to the fact that in a significant proportion of women, IIAL was performed as an accompaniment to hysterectomy especially in some cases of uterine atony at a time during which misoprostol and tranexamic acid were not freely available. This could also be due to the fact that a considerable number of women whose uteri were saved by the procedure are still contemplating whether to embark on a pregnancy or not, or else it is still too early to think about a pregnancy. However, none of these women whose uteri have been salvaged, are experiencing any change in their menstrual patterns. Therefore, it is reasonable to assume that their fertility too has been preserved, and time should prove me right.

Evidence available globally, although scarce, confirms not only that this procedure does not affect fertility, but also that the outcome in pregnancy is successful. A systematic review which was conducted to find an answer to the growing concerns in the recent past of whether fertility was affected not only by IIAL but also by any of the conservative surgical measures employed in the management of PPH which included compression sutures, pelvic arterial embolization and stepwise devascularisation of the uterus concluded that fertility was not affected by any of these uterus sparing measures.

Studies have affirmed the authoritative role IIAL plays even in the event of failure of other uterus sparing techniques to control the haemorrhage, and also that fertility was not affected even when IIAL was combined with any of the other uterus sparing measures utilized in PPH.

Place of internal iliac artery ligation today

The most commanding role of interruption of internal iliac arteries is in the field of obstetrics, and that in the management of PPH. The internal iliac arteries are also interrupted in the fields of gynaecology, vascular surgery, oncology and trauma. A systematic review, the results of which were published in the *Journal of Vascular Surgery*, which was conducted to ascertain the rate and risk factors for the development of ischaemic complications such as buttock claudication, buttock necrosis, erectile dysfunction, colonic, spinal cord and bladder ischaemia following interruption of the internal iliac arteries among patients across all these specialities concluded that the intervention was safer in obstetric patients compared to patients in other groups. It also recommended that ligation of the internal iliac arteries was preferable to embolization among all groups of patients.

What may be the reasons behind the low rate of complications witnessed in the obstetric population following interruption of the internal iliac arteries? The obstetric patients are generally fit and young, and the elevated oestrogen levels may help keep the collaterals dilated. In addition, obstetric patients are also likely to be free from atherosclerotic disease which is more prevalent in patients in other groups. Atherosclerotic disease will obviously compromise the blood circulation in the collaterals. Another factor that would

have contributed to the low complication rate witnessed in the obstetric population, which has not been addressed by the authors in this study, may be the fact that the posterior division of the internal iliac artery tends to be untouched in the obstetric patients. Some of the side effects encountered following interruption of internal iliac arteries especially buttock claudication, buttock necrosis and erectile dysfunction can be attributable to the inclusion of the posterior division in to the ligation. Therefore, we can conclude that even the few complications which are encountered following interruption of the internal iliac arteries in specialities other than obstetrics are almost non existent in the field of obstetrics.

Conclusions

What lies ahead for IIAL, a manoeuvre that has silently accomplished its task of saving lives over the years?

The emergence of novel uterotonic agents for management of uterine atony, the anti-fibrinolytic agent, tranexamic acid, and relatively less invasive techniques utilised in the management of PPH, and most importantly one's reluctance to perform the procedure when necessary have pushed IIAL almost to the threshold of being eliminated from our speciality.

The procedure of IIAL should and will remain indispensable from the armamentarium of the obstetrician especially in resource depleted settings with no or limited access to interventional radiology, and in the event of unanticipated bleeding even in the best of the maternity centres anywhere in the world. One has only to rely on one's most trustworthy instruments, one's hands, in order to perform IIAL.

The procedure will also remain irreplaceable as a means of combatting precarious haemorrhage resulting from genital tract trauma and its value in the management of placenta praevia and accreta, two potentially lethal conditions associated with caesarean delivery, will forever remain priceless.

Every minute, one woman goes missing from this world. One woman goes missing during pregnancy or childbirth. A child is born without ever getting to experience the love or the warmth of its mother, and haemorrhage is a major contributor. Haemorrhage is the leading cause of maternal deaths in developing

countries, and ranks among the top three in developed. Haemorrhage is responsible for a quarter of maternal deaths which occur worldwide. In Sri Lanka, haemorrhage has accounted for a significant proportion of maternal deaths which occurred during the past few years, once dengue and respiratory diseases have been left aside.

More than a century has elapsed since the first IIAL was performed for precarious pelvic hemorrhage. Yet today, serious haemorrhage persists among the leading causes of death and serious maternal morbidity, preventable in most instances in our speciality by the simple, safe, and effective manoeuvre of IIAL.

Therefore, it is imperative that every obstetrician is conversant with the art of ligating the major blood supply of the pelvis, the internal iliac arteries, an essential lifesaving manoeuvre in one's armamentarium.

'Skill is something one never knows when one may need it. It is better for one to have the skill and never get to use it, than not have it and one day need it'.

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