

Uterine Artery Ligation in Postpartum Haemorrhage

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Abstract

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Background. Postpartum haemorrhage (PPH) is still the single biggest reason women die in childbirth. About a quarter of maternal deaths in the world are caused by it, and almost all of these deaths happen in poor and middle-income countries. When uterotonics, tranexamic acid and balloon tamponade fail to stop the bleeding, the surgeon has to act quickly. Uterine artery ligation (UAL), first

described by O'Leary in 1966, is one of the oldest yet most useful surgical options available in such an emergency. **Objective.** This review looks at the role of uterine artery ligation in the modern management of PPH. The technique, indications, success rates, complications and long-term reproductive outcome are discussed, along with a comparison against internal iliac artery ligation and uterine artery embolization. **Methods.** A narrative review was carried out using PubMed, Google Scholar and the Cochrane Library. Articles published in English from 2000 onwards were screened. Guidelines from FIGO, WHO, RCOG and ACOG were also reviewed. Cohort studies, case series of more than ten patients, systematic reviews and meta-analyses were considered. **Results.** The success rate of bilateral UAL in stopping intractable PPH lies between 80 and 96 percent in most published series. Stepwise devascularization, in which ligation is extended in stages, raises this figure even further. Complications are rare. Doppler studies have shown that the ligated arteries recanalize within a few weeks and

menstruation and fertility return to normal. Compared with internal iliac artery ligation, UAL is easier, faster and more effective. **Conclusion.** UAL deserves a clear place as the first surgical step in PPH that does not respond to medical treatment, especially in centres where interventional radiology is not available. Training young obstetricians in this simple procedure can lower the rate of peripartum hysterectomy and save lives.

Keywords. Postpartum haemorrhage; uterine artery ligation; O'Leary suture; uterine devascularization; maternal mortality.

Introduction

Childbirth should be a moment of joy. Yet for many women, especially in poor regions of the world, it ends in tragedy because of uncontrolled bleeding after delivery. Postpartum haemorrhage is the leading direct cause of maternal death today, just as it was a century ago. The WHO estimates that around 14 million women suffer PPH every year and nearly 70,000 of them die from it. Almost all of these deaths take place in low-resource countries where help arrives too late or not at all.

Bleeding after delivery is called primary PPH when blood loss reaches 500 ml after a vaginal birth or 1000 ml after a caesarean within 24 hours. Severe PPH is defined as blood loss above 1000 ml. The 2022 FIGO recommendations still use these cut-offs, although they also stress that the clinical picture matters more than the exact number of millilitres.

There are four main reasons why a woman bleeds after delivery, often remembered as the four Ts: tone, trauma, tissue and thrombin. Atonic uterus is by far the commonest, responsible for around seventy percent of cases. Trauma to the genital tract comes next, followed by retained tissue and finally coagulation problems. The initial management is the same regardless of the cause: rub up a contraction, give oxytocin, then ergometrine or carboprost, add tranexamic acid, and place a balloon if bleeding continues.

When all of this fails, surgery becomes the only option. In the past, a hysterectomy was often performed at this stage. It saves the woman's life but takes away her uterus, often before she has completed her family. The emotional and psychological cost is heavy, particularly in cultures where childbearing carries strong social meaning. For this reason, obstetricians have, over the years, looked for ways to stop the bleeding while keeping the uterus intact.

Uterine artery ligation is one such method. O'Leary first described it in 1966, and his original paper, based on a personal series of over a hundred patients, showed that simple ligation of the ascending branch of the uterine artery bilaterally could control bleeding in nearly all cases. The technique was forgotten for some years, then

rediscovered in the 1980s and 1990s when modifications by Fahmy, Tsurulnikov and AbdRabbo extended its use. Today the procedure is included in nearly every major guideline as a first-line surgical option for intractable PPH.

This review brings together the evidence on uterine artery ligation in PPH. The pathophysiology, technique, success rate, complications and reproductive outcome are discussed. The procedure is also compared with internal iliac artery ligation and with uterine artery embolisation, since these are the main alternatives in current practice.

Materials and Methods

Design

This is a narrative review. Narrative methodology was chosen because the relevant literature spans more than five decades and consists mostly of cohort studies, case series and guidelines rather than randomised trials. A narrative approach allows these heterogeneous sources to be brought together into a single clinically useful summary.

Search strategy

PubMed, Google Scholar, the Cochrane Library and Scopus were searched. The publication date cut-off was January 2000 to October 2025. However, a small number of older landmark papers, including the original O'Leary article from 1966 and the AbdRabbo paper from 1994, were also included for their historical importance. The search terms used were "postpartum haemorrhage", "uterine artery ligation", "O'Leary suture", "uterine devascularization", "stepwise devascularization", "Tsurulnikov", "internal iliac artery ligation", "uterine artery embolisation" and "peripartum hysterectomy". Boolean operators AND and OR were used in different combinations. The reference lists of retrieved articles were also screened by hand.

Selection criteria

Studies were included if they reported the technique, indications, success rate, complications or fertility outcome of uterine artery ligation in primary or secondary PPH. Cohort studies, case series with more than ten patients, systematic reviews, meta-analyses and authoritative clinical guidelines were considered. A few case reports were included only where they showed an unusual complication or a technical point not covered elsewhere. Non-English publications and animal studies were left out.

Synthesis

Data on patient characteristics, indication, surgical method, success, complications and reproductive outcome were collected. Because of the heterogeneity of the studies, no attempt was made at quantitative pooling. Findings are presented under thematic headings and summarised in three tables.

Results

Why ligation works: anatomy and physiology

The uterus is one of the most heavily vascularised organs in the pregnant body. At term, blood flow through the uterine arteries reaches almost 700 ml per minute, which is roughly ten percent of the maternal cardiac output. The main supply comes from the uterine arteries, which arise from the anterior division of the internal iliac artery on either side. The ovarian arteries, which come directly off the aorta, add a smaller share. There are also minor contributions from the vaginal artery and from branches running in the round ligament.

Tying off the ascending branch of the uterine artery cuts down uterine perfusion by close to ninety percent. This drop is enough for the natural mechanisms of haemostasis, namely myometrial contraction and platelet plug formation, to take over and seal the open vessels. The uterus does not become ischaemic because the collateral circulation, especially from the ovarian arteries, keeps the tissue alive. After a few weeks, the ligated vessels also recanalise, which has been confirmed by Doppler studies. This is the reason why menstruation comes back, conception happens, and pregnancy outcomes are not affected in the long run.

When to do Uterine Artery Ligation

UAL is considered when the woman keeps bleeding even after uterotonics, tranexamic acid, bimanual compression and balloon tamponade have been used. The decision is most often made during a caesarean section when bleeding becomes obvious before the abdomen is closed. It is also a useful option during laparotomy carried out for PPH after a vaginal delivery. Common indications include atonic uterus, bleeding from a placenta previa bed in the lower segment, focal accreta, and continued ooze after repair of a uterine rupture. Women who want more children, and those in centres without interventional radiology, are particularly suitable candidates.

Table 1: *Lists the usual causes of PPH that may bring the surgeon to consider arterial ligation.*

Cause	Pathology	Frequency
Tone	Atonic uterus; the myometrium does not contract after delivery	Around 70%
Trauma	Tears of the cervix, vagina or perineum; rupture of the uterus	About 20%
Tissue	Retained placenta or membranes; placenta accreta spectrum	Nearly 10%

Cause	Pathology	Frequency
Thrombin	Disorders of coagulation, either pre-existing or acquired	Less than 1%

The Surgical Technique

The O'Leary Suture

The procedure is straightforward but a few points matter. After the baby and placenta have been delivered, the uterus is brought out of the abdomen. The bladder peritoneum is reflected downward to give a clear view of the lower segment and the uterine vessels on the lateral wall of the uterus. A large curved needle on number 1 polyglactin or chromic catgut is used.

The needle goes in from front to back through the myometrium, about two to three centimetres medial to the lateral border of the uterus, at the level just below the uterine incision. From the back, the needle is then brought forward through an avascular window in the broad ligament, lateral to the uterine vessels. The suture therefore encircles the ascending uterine artery, the accompanying veins and a small bite of myometrium. The knot is tied snugly but not tight enough to cut through tissue. The same step is repeated on the other side.

Hemostasis is usually obvious within a couple of minutes. The uterus becomes pale and firm, and bleeding from the placental site slows down. The bladder must be reflected enough before the suture is taken; if not, the suture can pick up the bladder wall and cause trouble later.

Tsirulnikov's Triple Ligation

When O'Leary's suture alone does not control the bleeding, the next step is to tie two more pairs of vessels in addition to the uterine artery: the round ligament artery and the utero-ovarian pedicle. This is the triple ligation described by Tsirulnikov in 1979. By blocking these extra channels, the collateral supply to the uterus is also reduced and bleeding usually stops.

AbdRabbo's Stepwise Devascularization

AbdRabbo, working in Cairo, took the idea further. He suggested a five step ligation done one step at a time, only as needed. The first step is unilateral uterine artery ligation. If bleeding does not stop, the same suture is placed on the other side. If bleeding still continues, a second pair of sutures is placed lower down, three to five centimetres below the first, to interrupt the cervical and vaginal branches. The last two steps are unilateral and then bilateral ligation of the ovarian vessels in the infundibulopelvic region. In his original series of 103 women, every single case was controlled and not one needed a hysterectomy.

How well does it work

Bilateral uterine artery ligation has been studied many times since O'Leary's original paper. Reported success rates range between eighty and ninety six percent. A large retrospective study from Hong Kong by Lin and co-workers included 173 women who had UAL as their first surgical step during caesarean section. Bleeding was controlled in 81.5 percent of women by UAL alone and in 96.5 percent when other measures, such as compression sutures or balloon tamponade, were added afterwards. The factors most often linked with failure were placenta previa and disseminated intravascular coagulation.

Combining UAL with a uterine compression suture, such as the B-Lynch suture, gives even better results. Several authors have reported success rates close to ninety five percent when the two techniques are used together, which suggests that the synergy between the two methods is real. Table 2 summarises the major uterus-sparing techniques.

Table 2: *Uterus-sparing surgical procedures for intractable PPH.*

Procedure	Surgical principle	Success
O'Leary suture	A single suture taken through the lower uterine segment, encircling the ascending branch of the uterine artery and a small bite of myometrium	80 to 96%
Tsirulnikov triple ligation	Three pairs of vessels are tied: the round ligament, the utero-ovarian pedicle, and the uterine artery	About 90%
AbdRabbo stepwise devascularization	Five sequential ligations are done one after the other, only as needed, until bleeding stops	Up to 100% in the original series
Internal iliac (hypogastric) artery ligation	The anterior division of the internal iliac artery is tied on both sides	Around 70%
Uterine artery embolisation	Selective embolisation of the uterine artery through a femoral catheter under fluoroscopy	85 to 96%

Complications

UAL is, on the whole, a forgiving operation. Serious complications are uncommon. The most frequent problem is a broad ligament haematoma, which can occur if the suture tears the uterine venous plexus. Ureteric injury is the most feared complication, but it is rare if the suture is placed medial to the broad ligament and not too low. The bladder can be caught in the suture if it is not properly reflected. Other reported but very rare complications are uterine necrosis, late synechiae and infection.

Fertility and Pregnancy after UAL

One of the reasons UAL has stood the test of time is that it does not seem to harm future fertility. Doppler studies done four to eight weeks after the operation have shown that the uterine arteries open up again and the blood flow pattern returns to normal. Iliodromiti and colleagues compared 47 women who had bilateral UAL, 59 who had bilateral hypogastric ligation and 50 controls. Subsequent miscarriage, fetal growth restriction, preeclampsia and infertility rates were similar in all three groups. The babies in the ligation groups were a little smaller and were delivered a little earlier than controls, but the differences were small in clinical terms.

UAL Versus Internal Iliac Artery Ligation

For many years, internal iliac (hypogastric) artery ligation was considered the gold standard for intractable PPH. Modern evidence, however, has shifted opinion. UAL is technically easier because the field is already open during a caesarean and the lateral border of the uterus is readily accessible. Internal iliac ligation, on the other hand, requires careful retroperitoneal dissection, identification of the ureter as it crosses the bifurcation of the common iliac, and careful avoidance of the iliac vein, which lies just behind the artery and tears easily.

The success rate of internal iliac ligation is about seventy percent, lower than that reported for UAL-based procedures. Operative time is also several times longer. A meta-analysis by Nabhan and co-workers, which included 795 women with placenta accreta spectrum disorders, found that UAL gave better bleeding control and fewer complications than IIAL. Table 3 sets out the main differences between the two procedures.

Table 3: *A side-by-side comparison of uterine artery ligation and internal iliac artery ligation.*

Feature	Uterine artery ligation	Internal iliac artery ligation
Technical level	Easy; field is already open during a caesarean	Difficult; demands retroperitoneal dissection
Time taken	Five to ten minutes	Thirty to forty-five minutes
Reported success	About 90%	About 70%
Major vascular injury	Rare	More likely, the iliac vein and ureter are at risk
Place in PPH algorithm	First surgical step	Used only after UAL fails
Future fertility	Not affected in published series	Not affected in published series

UAL Versus Uterine Artery Embolization

Uterine artery embolization is performed by an interventional radiologist through a femoral catheter. It is minimally invasive and has the advantage of stopping bleeding without a laparotomy. Reported success rates lie between eighty-five and ninety six percent. The catch is that it can only be done in a stable patient, in a hospital with a working angiography suite and a trained radiologist available around the clock. In most district and rural hospitals, especially in South Asia and sub-Saharan Africa, none of these conditions are met. UAL, by contrast, can be done anywhere a caesarean section can be done, by any obstetrician with the right training and a packet of absorbable suture.

Discussion

The findings of this review confirm a simple message that has stayed the same for almost sixty years: uterine artery ligation works, it works well, and it works in almost any setting. The success rates reported in the literature are remarkably consistent, despite differences in patient populations, definitions of success and surgical experience.

Why then is UAL not used as often as it should be? Several reasons stand out. Many young obstetricians today are trained in centres with quick access to interventional radiology and have never seen the procedure done. Others rely on hysterectomy as the next step after balloon tamponade, jumping straight from a uterus-saving measure to a uterus-removing one. Time pressure also plays a role. When a

woman is bleeding, the simple, familiar option feels safer than an unfamiliar one, even when the unfamiliar one is easier.

The stepwise approach of AbdRabbo deserves a special mention. Rather than thinking of arterial ligation as a single operation, it is more useful to think of it as a graded strategy. The first step is simple bilateral ligation of the ascending uterine artery. If that fails, the same suture is placed lower down to catch the vaginal branches. If that fails too, the ovarian vessels are tied off. By the third step, the uterine blood supply has been interrupted at every major level, and almost no bleeding can survive. The beauty of this approach is that, in most cases, only the first one or two steps are needed.

Combining UAL with uterine compression sutures is another point worth highlighting. The two techniques address different problems. UAL reduces inflow; compression sutures squeeze the cavity. When used together in atonic PPH, they often succeed where either alone would fail. The 2022 FIGO algorithm explicitly recognises this combined approach.

There are also caveats. UAL does not work as well in bleeding from the lower uterine segment, for example in placenta previa with deep accreta, because the cervical and vaginal branches contribute heavily to the bleeding in that region. In such cases, low uterine artery ligation and, if needed, internal iliac artery ligation may be required. Disseminated intravascular coagulation is another situation in which arterial ligation alone will not stop bleeding; correction of the underlying coagulopathy is essential before any surgical step can succeed.

The fertility data, while reassuring, come mostly from observational studies with selection bias. Women who go on to conceive after PPH are not a random sample of those who had the procedure; they are usually the ones who recovered well. Even so, the absence of any consistent signal of harm across multiple studies is encouraging and supports the use of UAL in women who want more children.

This review has limitations. Most of the data are retrospective. There are no randomised trials directly comparing UAL with other surgical options, and such trials would be very difficult to perform in an emergency setting. The definitions of success vary from study to study, and not all authors report long term outcomes. Despite these limitations, the consistency of findings across decades and continents gives strong support to the conclusions drawn here.

Conclusion

Uterine artery ligation is a procedure of unusual value in modern obstetrics. It is old, but it is not outdated. It is simple, but it is not crude. With a success rate of eighty to ninety

six percent, a very low complication rate, and no long term effect on fertility, it offers a way to save both the mother and her uterus in the middle of an obstetric emergency.

Where interventional radiology is not available, which is the case in most of the world, UAL should be the first surgical step after medical management fails. The O'Leary suture, the Tsurunikov triple ligation and the AbdRabbo stepwise devascularization should all be in the working knowledge of every practising obstetrician. Combining UAL with a uterine compression suture should be considered whenever atony is the cause of bleeding.

Wider training in this procedure, simple checklists in the labour ward, and clear escalation pathways at the hospital and national level can, together, reduce the rate of peripartum hysterectomy and bring down maternal deaths from PPH. Future research is needed in two areas in particular: prospective comparison of stepwise devascularization with combined uterine compression and tamponade, and long-term reproductive outcomes after stepwise devascularization. Until that evidence arrives, the available data are clear enough to act on. Every obstetrician should know how to tie off a uterine artery.

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