

Uterine Compression Sutures in Controlling Postpartum Haemorrhage: A Narrative Review

Suturas Uterinas de Compressão no Controlo da Hemorragia Pós-Parto: Uma Revisão Narrativa



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ABSTRACT

Introduction: Postpartum haemorrhage is still the main cause of maternal morbidity and mortality. Many treatments are available, but they may threaten fertility potential. As a uterine sparing procedure, we aimed to review uterine compression sutures in order to better understand when they should represent an appropriate option.

Material and Methods: A comprehensive search in MEDLINE and PubMed databases including the terms 'postpartum haemorrhage' and 'uterine compression sutures' was performed. Results were revised and articles reviewing or presenting case reports of uterine compression sutures to treat postpartum haemorrhage were included.

Results: The first description of uterine compression sutures to control postpartum haemorrhage was published in 1997, by B-Lynch *et al.* After this publication, many others have reported successful management of postpartum haemorrhage with different suturing techniques. Most of them describe success rates above 75% and the possibility of fertility preservation, with cases of uneventful pregnancy after uterine compression sutures already published. Complications associated with each technique are rare.

Conclusion: Uterine compression sutures are effective, safe and simple to perform in an emergent situation and preserve fertility potential in cases of postpartum haemorrhage.

Keywords: Hysterectomy; Obstetric Labour Complications; Postpartum Hemorrhage; Sutures

RESUMO

Introdução: A hemorragia pós-parto é a principal causa de morbimortalidade materna. Apesar dos tratamentos disponíveis, o potencial fértil da mulher pode ser colocado em causa. As suturas uterinas de compressão representam uma terapêutica conservadora do útero. Assim, revimos os tipos de suturas uterinas de compressão para compreender quando devem ser uma opção terapêutica.

Material e Métodos: Foi realizada pesquisa na MEDLINE e PubMed com os termos 'postpartum haemorrhage' e 'uterine compression sutures' separados e em conjunto. Os resultados foram revistos e os artigos de revisão ou descrevendo casos clínicos de suturas uterinas de compressão foram selecionados.

Resultados: Em 1997, B-Lynch *et al* descreveu pela primeira vez as suturas uterinas de compressão para tratamento da hemorragia pós-parto. Desde aí, publicações de diferentes tipos de suturas uterinas de compressão, com registo de casos bem-sucedidos, têm sido publicadas. A maioria reporta taxas de sucesso acima de 75%, com preservação da fertilidade, existindo vários casos de bom desfecho obstétrico posteriormente descritos. As complicações associadas são raras.

Conclusão: Em situações de hemorragia pós-parto, as suturas uterinas de compressão são eficazes, seguras e simples de realizar, preservando o potencial reprodutivo.

Palavras-chave: Complicações do Trabalho de Parto; Hemorragia Pós-Parto; Histerectomia; Suturas

INTRODUCTION

Postpartum haemorrhage is an obstetrical emergency and the major cause of maternal morbidity and mortality.¹⁻⁴ It is challenging: it can occur during the first twenty-four hours until twelve weeks after delivery, and estimating blood loss is difficult, as bleeding is not always visible.^{2,5} However, its recognition is vital as it requires immediate action.^{4,6-9} Uterine atony is the most frequent cause, despite prophylactic measures during the third stage of labour.⁸ Other causes are vaginal or uterine trauma, retained placental fragments or coagulopathies.^{1,3} Medical treatment is the first approach, but in many situations other interventions are needed, namely when the haemorrhage is severe, requires blood transfusion or causes haemodynamic instability.^{4,6,9-14} A surgical approach to uterine atony depends on its cause

and may ultimately lead to hysterectomy. Conservative techniques are first attempted to control postpartum haemorrhage and avoid hysterectomy: balloon tamponade, uterine compression sutures, uterine artery ligation, hypogastric artery ligation, and selective radiological arterial embolization.^{6,14-16} Despite many pros and cons of these techniques, Doumouchtsis *et al*⁶ points that so far there is no evidence to suggest that any method is better than another.

Nevertheless, uterine compression sutures (UCS) are a conservative option and their results in controlling postpartum haemorrhage are encouraging given efficacy and potential to preserve fertility.^{6,9-11,13,14,17} Since the first cases presented by B-Lynch *et al*,¹⁸ many others have published results on uterine compression sutures' efficacy in

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postpartum haemorrhage due to uterine atony. These reports describe different suture techniques that may be used to treat uterine atony or haemorrhage due to placenta praevia or accreta.^{16,18-31}

Given the importance of uterine compression sutures to preserve fertility potential, we aimed to present the different types of sutures, how they are performed, their complications and impact on fertility. Our final goal was to understand when and how these techniques should be chosen over more interventional surgical procedures and which one is more suitable for each situation.

MATERIAL AND METHODS

We have performed a comprehensive search in the MEDLINE and PubMed databases including articles pub-

lished between 1997 and June 2018, with the terms 'uterine compression sutures' and 'postpartum haemorrhage' combined. Results included 126 articles whose abstracts were analysed by two authors (Fig. 1). Articles reviewing postpartum atony treatments (including UCS), presenting series of cases or case reports of UCS and/or techniques of UCS, and those presenting results or reviews of uterine compression sutures' results and follow-up were included. In case of disagreement between authors, a third opinion was sought. In some cases, in order to better understand and strengthen the evidence, articles referenced in the selected articles were also included in the final review.

RESULTS

Types of uterine compression sutures

B-Lynch *et al*¹⁸ were the first to report five women who were successfully treated with uterine sutures after life-threatening postpartum haemorrhage. Regardless of whether the delivery was vaginal or by caesarean section, a Pfannenstiel incision of the abdomen and a lower segment incision of the uterus are needed. The uterus must be exteriorised to assess the bleeding cause, and if uterine atony is the most likely diagnosis, bimanual uterine compression should be performed to verify the technique's potential success.^{18,25} The suture begins below the right inferior limit of the uterine incision, inserting the needle through the anterior uterine wall. The needle is exteriorized again in the anterior uterine wall above the superior border of the incision. The thread then goes to the uterine posterior wall, passing above the fundus, and then the needle is inserted through the posterior wall in a point corresponding to the thread's anterior exit. Afterwards, the needle should be inserted a few centimetres laterally to the entry point, and the thread is then passed longitudinally through the fundus to the anterior wall. The needle is then inserted above the left superior margin of the uterine incision through the uterus wall and exits on the inferior margin (parallel to the first stitches). An assistant should compress the uterus while the surgeon pulls the thread firmly and applies a strong knot (Fig. 2). Finally, the uterine incision should be closed.^{18,25} B-Lynch *et al*¹⁸ also advocate UCS in cases of placenta praevia, performing an independent figure-eight suture anteriorly, posteriorly, or both, prior to the application of their suturing technique.

Most of the techniques reported after B-Lynch's work present subtle variations. Bhal *et al*²⁶ have described two sutures which start by inserting the needle below the uterine section and passing it through the uterine wall until it reaches the posterior side of the uterus. Then, the thread passes above the uterine fundus exteriorly until the anterior side of the uterus, where the needle is inserted above the uterine section and crosses the anterior wall, exiting below the section in a point superior to the initial inserting needle spot. The procedure was repeated on the other side, and two knots were tied in the anterior-inferior margin of the lower uterine segment.²⁶ Nelson and Birch,³² bearing in mind the risk of lateral thread slipping above the fundus during

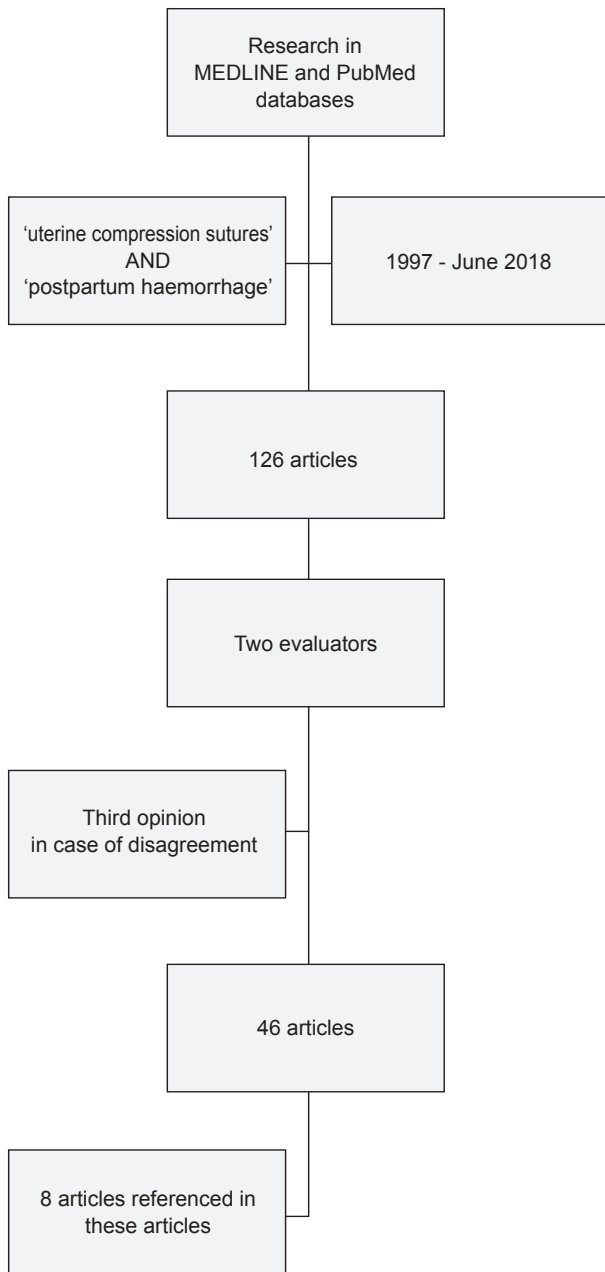


Figure 1 – Simplified article selection flowchart

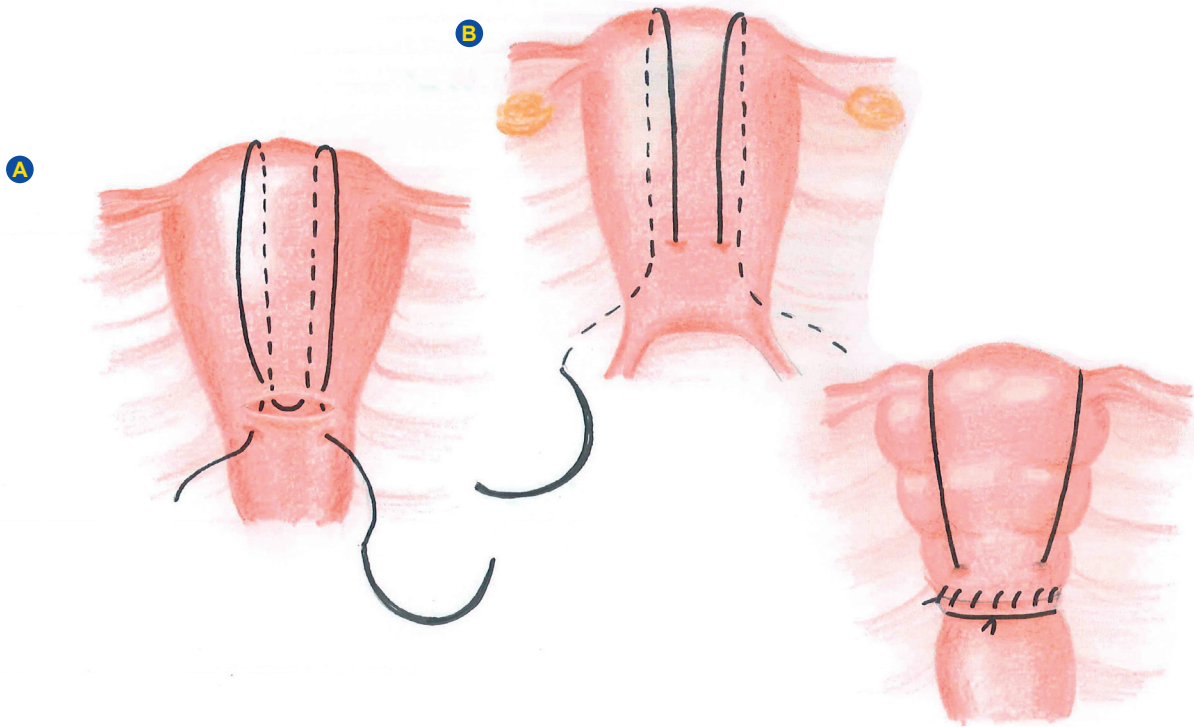


Figure 2 – B-Lynch suture.⁵⁴ (A) Anterior view of the uterus before performing the knot, showing how the thread passes through the uterine wall; (B) Posterior aspect of the uterus before performing the knot; (C) Anterior view of the compressed uterus after performing the knot and the suture of the hysterotomy. Dashed lines represent the suture on the posterior aspect of the uterus.

uterine involution, have proposed a suture initiated like in the technique by B-Lynch, but when the needle comes out anteriorly above the hysterotomy site, the thread is not passed above the uterine fundus. Instead, the needle is introduced through the uterine fundus until its posterior aspect. Then, the thread runs along the posterior wall and the needle is inserted again in the lower segment of the uterus through the uterine cavity until the anterior wall, exiting below the uterine incision (Fig. 3A). The same steps are repeated on the other side, and knots are tied tightly on the anterior aspect of the uterus.³² Marasinghe *et al*^{31,33} have also claimed to avoid the sutures slip off the uterine fundus, using two sutures beginning anteriorly below the uterine section. The needle is passed through the uterine cavity until its posterior side, where the thread is passed over the fundus until the

anterior wall; there, the needle is inserted below the fundus, passing the uterine cavity until its posterior wall; the thread is then passed over the fundus, reaching the anterior aspect, where a tight knot is performed (Fig. 3B). The procedure is repeated on the other side.^{31,33}

More recently, the use of a double B-Lynch suture was described as successful in 14 cases where only one suture was unable to control haemorrhage. Authors performed the original B-Lynch technique and the second suture 0.5 cm from the lateral side of it.³⁴ Another modification of the technique was performed in 19 women in whom Mansoura-VV sutures were applied. They use two longitudinal sutures that pass through the uterine cavity below the hysterotomy incision (one left and one right). The knots are tied in the uterine fundus as the thread is divided in two, creating a V-shaped

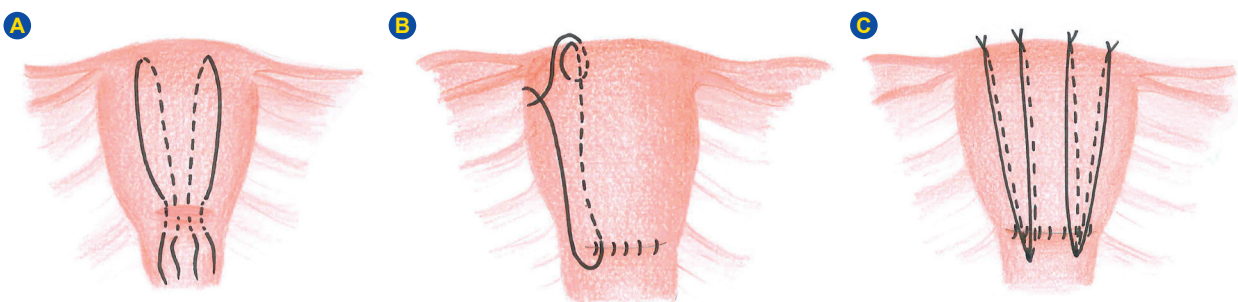


Figure 3 – Longitudinal sutures variations. (A) Nelson and Birch's description of uterine compression sutures.³²; (B) Marasinghe *et al* technique to avoid thread slipping over the uterine fundus.³³; (C) Mansoura VV-suture.^{21,35} Dashed lines represent the suture on the posterior aspect of the uterus.

suture (Fig. 3C).^{21,35} El-Sokkary *et al*²² have published another variation: it begins on the anterior aspect of the uterus below the hysterotomy, but the thread, after exiting above the hysterotomy, crosses the uterine fundus on the contralateral side and is inserted in the posterior wall on that same side. On the posterior aspect of the uterus the suture is performed as B-Lynch description but on the anterior wall the thread crosses again creating an X-shaped suture.²²

The association of B-Lynch suture with other postpartum haemorrhage control techniques have also been described. Nelson and O'Brien²⁹ have reported five cases in which B-Lynch's compression sutures were performed but were not successful, so they've applied an intrauterine Bakri balloon – 'uterine sandwich technique'. According to the authors, after placing the balloon, the hysterotomy incision is closed and the balloon is filled with normal saline while observing the uterine response to tamponade.²⁹ Similar descriptions also support the success of these combined strategies.³⁶⁻³⁸

Cho *et al*¹⁹ have published their experience in controlling postpartum haemorrhage due to uterine atony, but also abnormal placentation, after caesarean delivery. This technique uses multiple square sutures to get anterior and posterior uterine walls closer so that no space is left between them and haemorrhage is controlled. It is performed in the bleeding area, where the anterior wall is punctured until the posterior aspect of the uterus. There, 2-3 cm laterally, the uterine wall is punctured again until the anterior wall, where 2-3 cm below or above a new point of the wall is punctured until the posterior side. Again, the needle is inserted until the anterior aspect of the uterus so that a square/rectangle is formed after the knot. This suture is repeated four to five times from the uterine fundus until its lower segment in cases of uterine atony. If placenta accreta is the bleeding cause, two to three areas in it are selected, and the square suture is performed; in cases of placenta praevia, the sites with heavier bleeding are selected, and sutures are performed.¹⁹ Two years after Cho's publication, Hayman and colleagues²⁴ have described a technique in which two to four longitudinal compression sutures are placed from the anterior to the posterior uterine wall (Fig. 4). A straight needle enters the anterior wall below the uterine incision

until the posterior wall, and a knot is made on the uterine fundus. This procedure can be performed on the other side so that two or more longitudinal sutures wrap the uterus and control haemorrhage. If an incision was not performed, the needle is inserted in the place where it should be. Hayman *et al*²⁴ also highlight the possibility of a transverse suture near the cervix when haemorrhage originates at that level, namely, in cases of placenta praevia: the needle passes through the anterior wall approximately 3 cm below the inferior caesarean section and 2 cm from the lateral border; on the posterior wall, the needle should then be inserted 1 cm medially on the same exit level passing through the uterine walls until the anterior one; the same procedure is repeated on the contralateral side.²⁴

Ouahba *et al*²⁸ have published a technique with four sutures to control postpartum haemorrhage in a series of 20 cases of uterine atony. The procedure consists of four uterine sutures inserted from the anterior to posterior wall; the needle is again inserted until the anterior wall approximately 8 cm from the initial point, and a tight double knot is tied on the anterior aspect of the uterus. Two of the sutures are transverse (one in the middle of the fundus and one in the lower segment) and two are oblique and placed 2-3 cm medial from the uterine horns.²⁸ Hackethal *et al*³⁰ have also described a technique where the suture enters the uterine cavity from the anterior to the posterior wall. The needle passes 2 to 4 cm from the initial point through the uterine cavity until it reaches the anterior aspect of the uterus, where a double knot is performed, resulting in a U-transverse suture. The number of sutures used depends on the uterine size and the persistence of the bleeding.³⁰

Being different from the ones already described, Pereira's suture includes longitudinal and transverse sutures around the uterus that do not cross the uterine wall, being inserted only superficially in the serous membrane and the subserous myometrium (Fig. 5).²⁷ Two to three transverse sutures should be performed first, starting from the superior one: it starts anteriorly by inserting the needle in the subserous myometrium and passing it through the broad ligament to the posterior side of the uterus; then, some bites of the subserous myometrium should be taken, and the

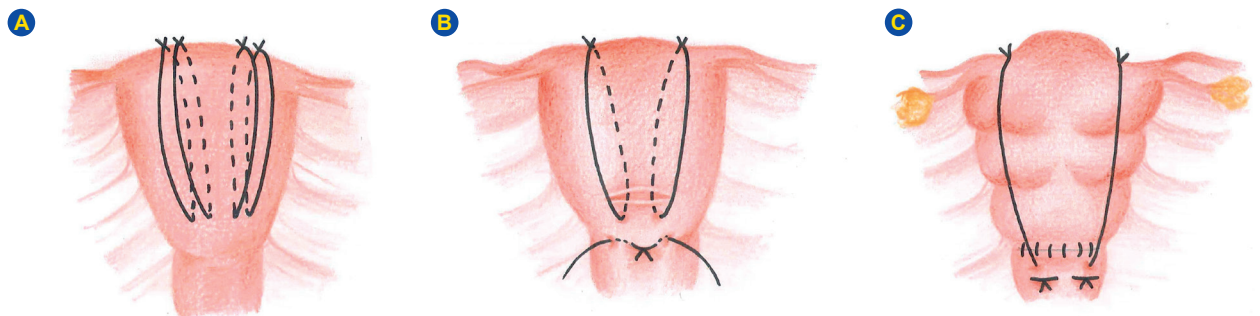


Figure 4 – Scheme of Hayman's *et al*²⁴ suture technique. (A) Anterior aspect of the uterus after a vaginal delivery, when no hysterotomy was needed.²⁴; (B) and (C) Anterior aspect of the uterine wall illustrating the transverse sutures also described by Hayman *et al*²⁴; (B) Aspect before the suture of the uterine incision; (C) Final aspect after performing the knots of both transverse sutures and closure of the hysterotomy.

Dashed lines represent the suture on the posterior aspect of the uterus.

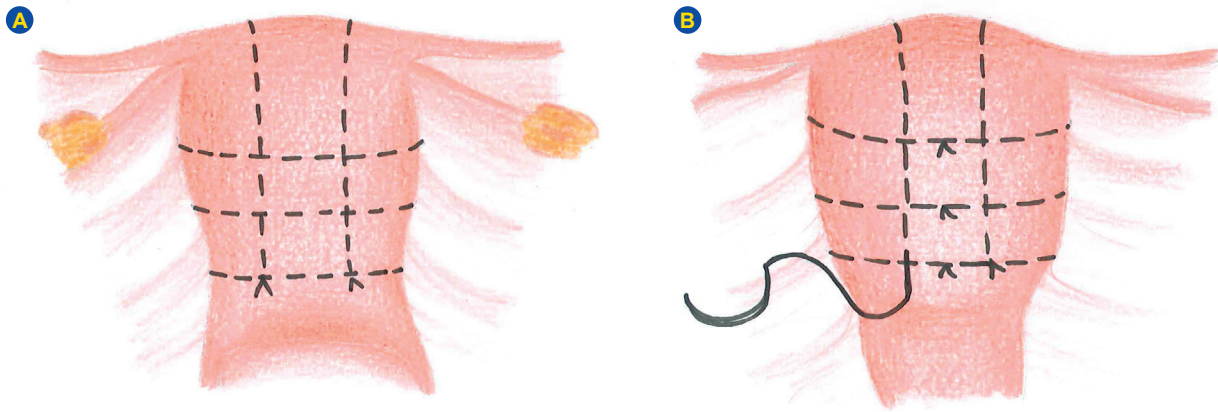


Figure 5 – Pereira's suture²⁷. (A) Posterior view; (B) Anterior view.

needle crosses the broad ligament again to the anterior wall, where the knot is performed. The number of bites depends on uterine size and tension that is perceived as necessary to compress the uterus. The most inferior transverse suture is used as an anchor to the knots of the longitudinal sutures, which should start on the posterior wall. After performing a knot to the lowest transverse suture, several bites of the subserous myometrium are taken until the anterior side of the uterus, where it should end. This procedure can then be repeated two to three times.²⁷ A modification of Pereira's technique has been recently described in two patients: longitudinal sutures were performed according to B-Lynch's technique, but additional transverse sutures included superficial bites involving only the serous membrane and the subserous myometrium like those used by Pereira.²³

Effectiveness of the different techniques

Kayem *et al*¹⁷ reported the efficacy of UCS after reviewing 199 deliveries which required UCS in the United Kingdom between September 2007 and March 2009. The most frequent technique chosen was the B-Lynch suture, and a modified version of it was the second most frequent option. The overall failure rate was 25%, and in these cases, a hysterectomy was necessary; the rate of failure did not differ significantly according to the suturing method. A higher risk of hysterectomy was observed when there was a prolonged delay of 2 to 6 hours between delivery and UCS, and when there was a vaginal delivery, maternal age was 35 years or older or when the woman was multiparous.¹⁷

A systematic review in 2007⁶ analysed the success rates of conservative techniques to control postpartum haemorrhage, and a success rate of 91.7% for UCS was estimated. It was noted that there was no statistically significant difference in success rates between conservative procedures, and therefore, the authors advised clinicians to use the least invasive, easiest and quickest approach, namely, balloon tamponade.⁶ These results have been recently corroborated by a Çetin *et al*³⁹ when comparing Hayman suture and Bakri balloon tamponade.

Ghezzi *et al*⁴⁰ reported eleven cases of massive postpartum haemorrhage in which ten were successfully controlled with UCS, and only one patient ultimately required

a hysterectomy. More recent articles reviewed comparative studies and case series and estimated a success rate of UCS of 71% to 75%.^{14,41} Variations of B-Lynch suture have also been reported as effective or even more effective than the original technique.^{22,34,35}

Although a randomized control trial comparing the different types of UCS' effectiveness is lacking, the results published so far point to a success rate between 36% and 98% (the majority of them above 75%).^{14,34,35,38} The technique chosen may not be the only contributor to different results. The time between the beginning of the haemorrhage, its diagnosis, previous medical treatment and the time by which the UCS are applied may be vital to success.^{14,34,35,38}

Complications related to uterine compression sutures

From the beginning, the importance of ensuring that compression of the uterus controls active haemorrhage before performing the suture has been outlined.^{18,25} Otherwise, the uterine suture may not be effective.

The cases described by Nelson and O'Brien,²⁹ which involved the uterine sandwich technique, were all successful in controlling postpartum haemorrhage, but the authors outlined one patient who developed endomyometritis and another with postpartum oliguria. The risk of endometritis has also been reported by Suzuki *et al*⁴² when evaluating perioperative complications of UCS in their hospital.

As the thread is passed through the uterine cavity in Hayman's and Cho's procedure, there is at least, a theoretical risk of blood trapping within it.^{25,43} Cho's suture could also interfere with physiologic uterine involution, and it was already reported to be associated with pyometra and uterine cavity synechiae.^{25,43-45} Also, a higher risk of uterine ischaemia and necrosis seemed to be associated with UCS combined with vessel ligation, so long-term follow up in these women is advisable.^{16,46,47} Pereira's technique does not involve suturing the anterior and posterior wall together, and the needle only enters the subserous myometrium without penetrating the uterine cavity. Therefore, the aforementioned risks are overcome and the risk of infection is reduced.^{27,43} Given the small size of the bites, it is believed that the risk of bowel or omentum trapping in the suture is low. This is a minimal risk even with other techniques due to

the applied compression and the fact that suturing materials are absorbed in a few weeks.⁴³

Given the absence of larger trials and the reporting biases regarding complications, it is important to bear in mind a possible higher risk of complications than what is reported in literature.

Results for future fertility and pregnancy outcome

Data regarding menstrual cycles and fertility post-UCS are scarce since follow-up is mostly short and only a few cases of long follow-ups have been reported. A 2013 review⁴⁸ about fertility rates and pregnancy outcomes after postpartum haemorrhage treated with UCS estimated a fertility rate ranging from 10% to 100%, noting lower performance with B-Lynch's and Hayman's modified procedures. Authors have explained this wide range with the information described in case reports, case series or even studies performed by surgeons who first described the techniques. Despite these important biases, they stated that the majority of pregnancies were mostly uneventful, but the most frequent mode of delivery was an elective caesarean section. It seems safer and ensures the quick management of postpartum haemorrhage complications since recurrence is not negligible.⁴⁸

These results are comparable to those obtained by

Doumouchtsis *et al.*⁴⁹ By analysing six studies assessing menstrual and fertility data after UCS, they estimated that more than 90% of women resumed normal menstruation. Between women who revealed a desire for a subsequent pregnancy, approximately 85% achieved conception. They noted that this desire may have been inadequately reported and that many women did not want another pregnancy after a life-threatening event.⁴⁹ Another review in 2013⁵⁰ evaluated the outcomes of subsequent pregnancies after UCS – Hayman's suture and the multiple square suture technique – at their hospital. They compared 42 women treated with UCS with 139 untreated women during their previous delivery by caesarean section. They concluded that all women treated with UCS who got pregnant conceived naturally and that pregnancy outcomes were similar (namely prematurity rates, estimated blood loss and rate of UCS in subsequent deliveries). It is important to point out that pelvic adhesions in a subsequent caesarean delivery were more prevalent in women who were treated with UCS. Despite the relevant number of women evaluated, this study only compared outcomes in pregnant women and did not assess the potential effect of UCS on fertility.⁵⁰

Cowan *et al.*⁵¹ compared adverse outcomes in subsequent pregnancies in women with postpartum haemorrhage treated with a B-Lynch suture *versus* women treated with

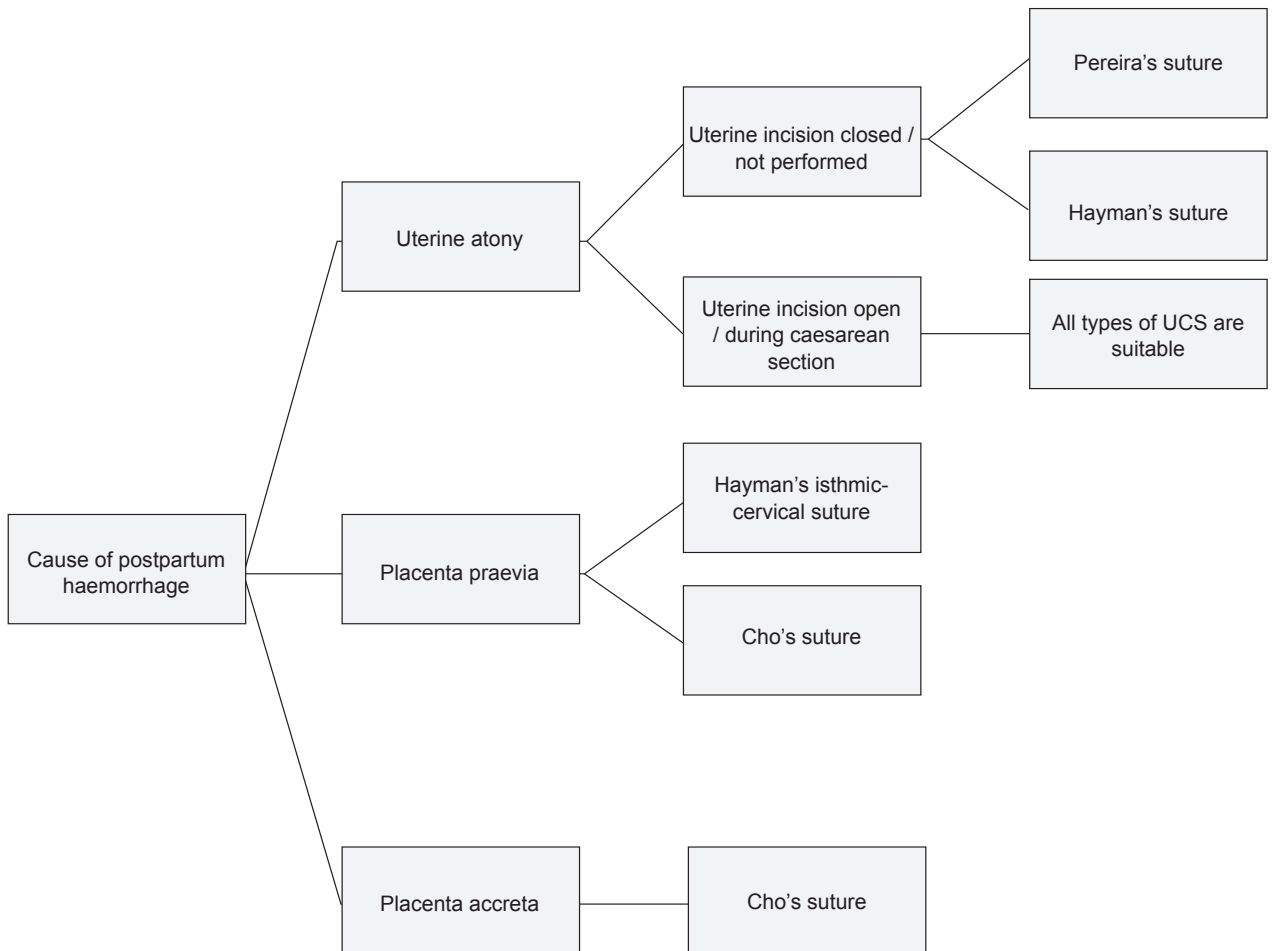


Figure 6 – Simplified flowchart on how to choose a uterine compression suture technique

another method (artery ligation and uterine artery embolization). They found no significant difference between groups, and they also found no association between the use of B-Lynch compression sutures and adverse outcomes in future pregnancies.⁵¹ Recent series of cases also support the possibility of successful pregnancy after UCS.³⁴

The overall conclusion from small reports to bigger reviews is that most women resumed normal menses and that those women who desired another pregnancy were able to conceive naturally with comparable outcomes to other women who did not undergo UCS on their previous caesarean delivery.

DISCUSSION

The choice of an optimal uterine suture technique

Although it exists, the evidence supporting UCS has poor quality, which has been a main conclusion of many studies. Nevertheless, almost every article and recent review about the conservative management of postpartum haemorrhage agrees with the relevant success rate of UCS and the simplicity of performing them under an emergent situation, even by obstetricians with less training.^{9,12,16,20,25,26,28,32,34,40,43,48-50}

Despite many similarities, these techniques have some specific characteristics that can make them more suitable in some situations. When choosing a UCS, at first, it is important to determine whether the uterine incision is already closed or was not performed (cases of postpartum haemorrhage after vaginal delivery in which a laparotomy was considered necessary). In these situations, Pereira's or Hayman's sutures are possible options^{24,27}(Fig. 6).

Equally important is the perceived cause of haemorrhage, since all UCS may be applied in cases of uterine atony, which implies the exclusion of other causes of postpartum haemorrhage. On the other hand, Hayman's technique²⁴ includes a possible isthmic-cervical suture to control haemorrhage due to placenta praevia and Cho's suture¹⁹ can also control postpartum haemorrhage due not only to placenta praevia but also placenta accreta (Fig. 6).

Ultimately, the surgeon's experience and knowledge about each technique will define the best approach since there are no randomized or controlled trials to compare the different types of UCS. It's also important to note that the option of a UCS should be considered as soon as possible when pharmacological measures fail to control

postpartum haemorrhage and a surgical option is considered.^{6,7,10,12-14,16,20,41,43,50,52,53}

CONCLUSION

Uterine compression sutures are a conservative treatment option to control postpartum haemorrhage that should be used when first line medical treatment isn't enough. They can be performed either after vaginal and operative delivery, do not require interventional radiology support and may be performed shortly after the onset of haemorrhage. The main reasons favouring this conservative surgical technique are its effectiveness but also its simplicity, while preserving women's fertility potential. The data published so far suggests that, after UCS almost all women resumed normal menses and could conceive spontaneously. Subsequent pregnancies tended to be uneventful. Also, complications described after UCS were rare.

Since there are no randomized control trials comparing UCS with other surgical conservative procedures or even comparing different types of sutures, critical judgement is vital. Nevertheless, the UCS success rates and its simplicity should lead to its inclusion in PPH treatment protocols before more complicated or aggressive surgical approaches like hysterectomy. It is vital to teach UCS in order to prepare every obstetrician to know when and how to perform each technique.

AUTHORS CONTRIBUTION

MLC: Research, data analysis, draft of the paper and critical review.

JB: Research, data analysis and critical review of the paper.

MJM: Critical review of the paper and design of the original images.

LGM: Concept of the work and critical review of the paper.

COMPETING INTERESTS

The authors report no competing interests.

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