



The Use of Vasopressor and Tourniquet to Reduce Hemorrhage during Myomectomy for Uterine Fibroid Removal: A Systematic Review

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Abstract

AIM: This review aims to evaluate the efficacy of vasopressin and tourniquet to reduce blood loss during myomectomy for uterine fibroids removal.

BACKGROUND: Uterine fibroids and uterine leiomyomata, the most common benign tumors in women, can be difficult for women trying to conceive. Surgical therapy, such as hysterectomy or myomectomy, is one of the main treatment options. Excessive blood loss may occur during the procedure. Clamps or tourniquets around the uterine vessels are commonly used as anti-bleeding precautions during myomectomy. Intra-myometrial injection of vasopressin at the base of the largest fibroids and during hysteroscopic myomectomy is effective in reducing blood loss during laparoscopic myomectomy.

METHODS: A literature search and computer-aided comprehensive electronic bibliographic search was performed using PubMed, Science Direct, SCOPUS, and Wiley for studies published from January 1997 to November 2017.

RESULTS: Ten studies met the eligibility criteria and were included in this review. Each study assessed and compared the effects of vasopressin to the control group that exerts a hormonal hemorrhagic effect during myomectomy procedures. About 50% of vasopressin hemostatic agents have better outcomes in reducing blood loss. However, the use of both vasopressin and tourniquet simultaneously failed to reduce blood loss.

DISCUSSION: Intramyometrial vasopressin injection resulted in a higher efficacy to decrease blood loss during myomectomy. Despite deciding which methods provide the most effective way to decrease blood loss, the two techniques showed excellent outcomes for the quality of the myomectomy procedure itself.

CONCLUSION: Hemostatic medications have shown to have positive effects on myomectomy patients. The predicted volume of blood loss significantly decreased by both the mechanical tourniquet approach and the injection of the hormone vasopressin.

Edited by: Mirko Spiroski
Citation: Djusad S, Bimo A, Futhandayani A, Herianti HF. The Use of Vasopressor and Tourniquet to Reduce Hemorrhage during Myomectomy for Uterine Fibroid Removal: A Systematic Review. Open Access Maced J Med Sci. 2024 Jan 23; 12(1):22-28. <https://doi.org/10.3889/oamjms.2024.11786>
Keywords: Vasopressin; Tourniquet; Myomectomy; Uterine fibroid
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Received: 05-Sep-2023
Revised: 13-Dec-2023
Accepted: 10-Jan-2024
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Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
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Introduction

Uterine fibroids, or uterine leiomyomata, are the foremost frequent benign tumors in women worldwide, originating in the myometrium [1], [2]. Common fibroids symptoms include abnormal uterine bleeding, pelvic pain, back pain, and disruption of surrounding pelvic structures (bladder, bowel, or rectum) [1], [2]. Patients may have limited work hours, imposing a significant financial burden on those who suffer from such conditions [2]. Fibroids can be a serious issue for women who yearn to be pregnant, as there is an apparent correlation between fibroids and infertility [1]. Clinicians must consider the patient's age, desire for fertility, and presenting symptoms when deciding on treatment options for uterine fibroids [1]. The available options are also determined by the size and location of the fibroids [1]. Management options include (1) surveillance for women with asymptomatic fibroids; (2) medical management to reduce the severity

of bleeding and pain symptoms, and (3) operative treatment as the gold standard therapy for fibroid [1].

Surgical options include hysterectomy and myomectomy, which depends on the size, extent, and totality of the fibroid [2]. These two procedures are basic surgical options for women who do not wish to retain their fertility [2]. However, hysterectomy carries a significant risk of intra-operative complications, such as excessive blood loss, myometrial hematoma, and morcellation accidents [3]. Hemorrhage can be caused by several factors, including inadequate use of vasoconstrictive agents, fibroid size, position, and number, lack of precision in suturing, inexperienced surgeons, loose knotting, and insufficient homeostasis [3]. Clamps or tourniquets are commonly used to prevent bleeding during surgery [4]. Prolonged uterine vessel occlusion, on the other hand, results in toxic substances that cause hypotension [4]. Only operations on uterine sizes up to 12 weeks gestational age or less are permitted without occlusion of uterine vessel [4].

Vasopressin, an antidiuretic hormone, has been used as a hemostatic agent during myomectomy and hysterectomy for over 50 years [5]. It primarily reacts to increased plasma osmolarity or decreased blood volume. Vasopressin causes uterine muscle contraction and vascular spasm [5]. Vasopressin intra-myometrial injection at the base of the great fibroids during hysteroscopic myomectomy reduces blood loss during laparoscopic myomectomy [4], [6]. These findings have been confirmed in various clinical trials. A tourniquet is the standard tool to achieve homeostasis; hence, a comparison with vasopressin was made. This review aims to assess the efficacy of tourniquet and vasopressin to reduce blood loss during myomectomy to remove the uterine fibroid.

Methods

Research strategy

Randomized clinical trials and retrospective studies were analyzed to rely on the fact that most suitable studies of hemorrhagic management in myomectomy procedure. Only fully published studies were searched. Additional records were identified through manual searches and bibliographies from other studies not identified in electronic searches.

The study selection process is following the four steps of PRISMA Statement's flow diagram, i.e. identification, screening, eligibility test, and inclusion of studies. 7 Studies were identified using the keywords described above. Duplicates removed and the retrieved studies were screened of their titles and abstracts, irrelevant topics or objectives are excluded from the study. The screening continues to the full article based on the inclusion and exclusion criteria that has been discussed and approved by all 3 reviewers.

Search strategy

Multiple databases including Pubmed, ScienceDirect, SCOPUS, and Wiley were explored following on the 6th of October 2020. The search strategy was structured using the keywords: (vasopressin) OR (ADH) AND (tourniquet) AND (myomectomy) and modified based on each database's search terms and condition. Randomized clinical trials and retrospective studies were chosen to rely on the fact that the most suitable studies of hemorrhagic management in myomectomy procedure. Only fully published randomized controlled trials and articles written in English were searched and included in the study. Any other languages other than English are not included in the study. The systematic review was conducted according to the PRISMA statement flow diagram [7].

Potentially relevant articles from the four databases were included in the study. Articles were then removed or excluded through a thorough search of duplicate articles and screened based on title and abstract. The full text of the remaining articles was assessed based on the review criteria, pre-defined.

Inclusion and exclusion criteria

Articles evaluating the effectiveness of vasopressin and tourniquets in the treatment of myomectomy hemorrhage were the primary selection criteria for this study; whether it is vasopressin versus tourniquet, vasopressin versus control, or tourniquet versus control. Exclusion criteria for this review include non-English articles, non-randomized subjects, incomplete or inaccessible text, participants undergoing treatment other than myomectomy for uterine fibroids, subjects with antihemorrhagic agents other than vasopressin and mechanical tourniquet, and studies that do not include the blood loss measurement. Studies estimating the efficacy of hemorrhagic agents other than vasopressin and tourniquet are excluded from this review.

Level of evidence

Ten included articles in the review are assessed based on their level of evidence using the Oxford Centre for Evidence-Based Medicine method [8]. Type of scientific design study, prognosis, diagnosis, differential diagnosis, and analysis of the articles are the key points to the assessment. Most of the studies involved in this review are categorized at the 2B level.

Results

Study characteristics

Searches identified 3, 60, 32, and 32 from database searching from PubMed, ScienceDirect, SCOPUS, and Wiley, respectively. In total, 127 articles were retrieved. After duplicates are immediately removed (n = 20), the remaining retrieved articles are going to the Title/Abstract screening, resulting in 24 studies being assessed for their eligibility. Ten obtained articles from the full-text screening and included in the qualitative scientific review (Figure 1).

From the ten articles that fittingly passed through the full-text eligibility test, each study gave different results related to the effectiveness of hemorrhagic agents on myomectomy procedures, that is, vasopressin and tourniquet. Fletcher *et al.* summarized that the injection of vasopressin (mean blood loss: 287.3 mL) obtained significant outcomes in

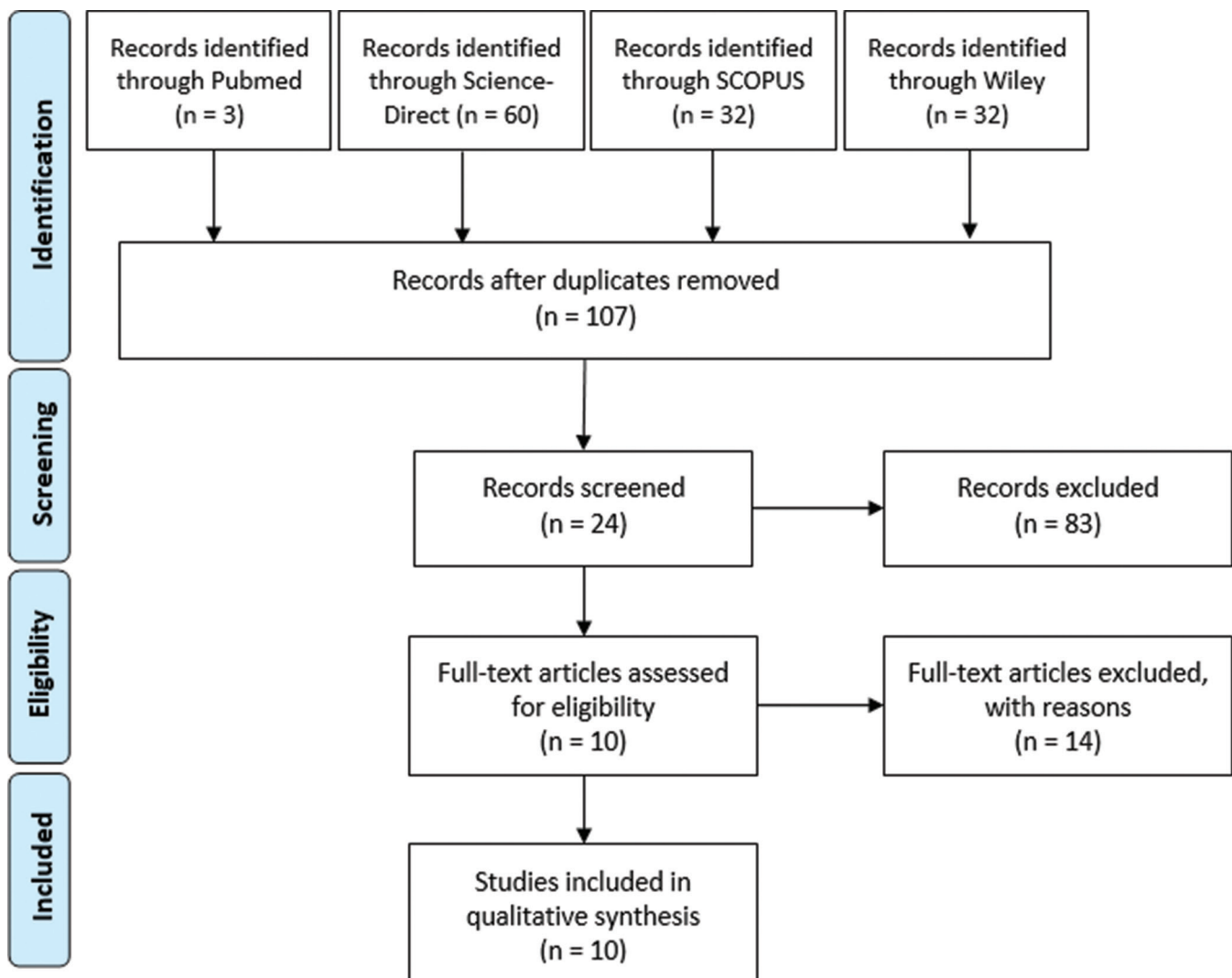


Figure 1: PRISMA statement flow diagram

reducing blood loss compared to the application of a mechanical tourniquet (mean blood loss: 512.7 mL) [4]. Saha *et al.* reported a similar deduction to the capability of vasopressin [6]. Nonetheless, Ginsburg *et al.* found no statistically significant evidence between the two techniques (461 ± 177 mL for vasopressin vs. 379 ± 95 mL for tourniquet) [9]. Meanwhile, studies investigated the effects of vasopressin compared to the control group exerted a hormonal hemorrhagic effect for myomectomy practices (Protopapas *et al.*, Dillon *et al.*, Cohen *et al.*, and Frederick *et al.*) [5], [10], [12], [13]. The same goes for studies comparing tourniquet applications with control groups (Sapmaz and Çelik; Taylor *et al.*) [11], [14]. Despite the high potency of both vasopressin and tourniquet - 319.8 ± 295.8 mL versus 509.5 ± 432.1 mL in estimated blood loss (EBL) of the combined group and vasopressin only, respectively, the combination fails to manifest a statistically significant decrease in EBL volume [15]. Despite the high potency of both vasopressin and tourniquet - 319.8 ± 295.8 mL versus 509.5 ± 432.1 mL in EBL for the combination group alone and vasopressin, respectively, the combination of both variables did not result in a statistically significant

decrease in EBL volume [15]. Although it is unclear which method is the most effective way to reduce blood loss, both techniques perform excellently in terms of the quality of myomectomy procedures. Vasopressin and tourniquets directly reduce morbidity and the amount of blood needed for transfusion [9]. Thus, it also helps to lessen the reduction in hemoglobin and hematocrit (Table 1) [6].

Discussion

This review demonstrates the effectiveness of tourniquets and vasopressin in reducing hemorrhage during myomectomy. Myomectomy surgery is notorious for its dangers and potential complications. Due to several effective surgical techniques, antibiotic agents, and efficient blood transfusions, the morbidity and mortality in myomectomy have been reduced [6]. However, severe bleeding complications yet remain [6]. According to previous studies, myomectomy may cause significant

Table 1: Study characteristics

Author	Aim	Study design	Samples	Result	Summary	Level of evidence
Fletcher et al. [4]	To assess the comparative efficacy of perivascular vasopressin and tourniquet in minimizing bleeding at myomectomy.	Randomized controlled trial	52 women with symptomatic uterine leiomyomas scheduled for myomectomy	Vasopressin resulted in less blood loss with a mean number of 287.3 (SD: 1951) mL versus 512.7 mL (SD: 4001) for the tourniquet. Six out of 26 patients from the tourniquet group lost more than 1000 mL of blood ($p = .023$).	Vasopressin prevents blood loss better than using the tourniquet during myomectomy.	1b
Ginsburg et al., [9]	To compare operative blood loss between vasopressin and tourniquet used during myomectomy	A prospective randomized study	25 women undergoing myomectomy stratified by ultrasound-determined uterine volume < 600 cm ³ (n = 11) and ~ 600 cm ³ (n = 10)	Vasopressin resulted in higher blood loss (461 ± 177) than mechanical tourniquet (379 ± 95). The amount of blood loss is correlated with the total weight of fibroids removed.	No significant differences in blood loss, morbidity, or transfusion requirements between the two techniques.	3b
Protopapas et al., [10]	To investigate whether the use of vasopressin played an important role in the safe expansion of the indications of laparoscopic myomectomy in our practice.	A retrospective comparison of prospectively collected data	150 cases undergoing laparoscopic myomectomies, of whom 50 treated without the use of any vasoconstrictive agent (group 1) and 100 were treated with intra-operative intramyometrial injection of dilute vasopressin (20 IU/100 mL normal saline) (group 2)	Mean estimated blood loss (EBL) was 321.8 ± 246.0 mL in group 1 and compared with 147.8 ± 171.8 mls in group 2 ($p < 0.001$).	Vasopressin is effective in reducing blood loss during laparoscopic myomectomy.	2b
Sapmaz and Çelik [11]	To compare the effects of ligation of the ascending branches of the uterine artery and tourniquet methods intra-operative and post-operative hemorrhage during abdominal myomectomy	Randomized controlled trial	51 cases with symptomatic myoma uteri that are randomly assigned into 2 groups, (i) treated with ligation of the uterine artery and (ii) intra-operative tourniquet method.	Intra-operative blood loss was lower in Group 1 (220 ± 50 mL) than in Group 2 (294 ± 60 mL)	Intra-operative blood loss is lower with bilateral ligation of the ascending branches of the uterine artery during myomectomy. The effect of ligation on hemorrhage continues in the post-operative period	2b
Dillon et al. [12]	To investigate and re-establish hormonal hemostasis in gynecologic surgery	Randomized controlled trial	59 cases undergoing myomectomy procedure, with 39 patients treated with vasopressin and the remaining 20 without the use of hemorrhagic agents.	Mean estimated blood loss (EBL) was 362 mL in cases treated with vasopressin compared with 818 mL in cases without hemorrhagic agents.	Vasopressin exerts a hemostatic effect when injected locally into the non-pregnant uterus.	1b
Saha et al. [6]	To compare intra-operative blood loss following abdominal myomectomy after receiving intra-myometrial vasopressin or tourniquet application	Randomized controlled trial	48 patients were divided into "T" and "V" groups which included 24 patients in each group. "T" group received conventional tourniquet application and "V" group received intra-myometrial vasopressin administration	The blood loss in the "T" group was significantly higher ($p \leq 0.001$). "T" group resulted in 467.9 ± 74.50 cc blood loss compared to "V" group which resulted in versus 356.5 ± 58.36 cc	Intra-myometrial vasopressin injection during myomectomy operation more effectively decreases the blood loss, and need for blood transfusion and it causes less reduction in hemoglobin and hematocrit.	1b
Cohen et al., [13]	To determine if higher-volume, fixed-dose administration of vasopressin further reduces blood loss at the time of minimally invasive myomectomy.	Randomized controlled trial	Women undergoing conventional laparoscopic or robot-assisted laparoscopic myomectomy separated in two groups: (A) treated with 200 mL diluted vasopressin and (B) 30 mL concentrated vasopressin solution	Both Groups A and B resulted in similar estimated blood loss, 45 (SD: 3.9) and 64 (SD: 3.2), respectively.	Mean blood loss was relatively low in both groups	1b
Frederick et al., [5]	To assess the efficacy of intra-myometrial vasopressin for minimizing bleeding and its sequelae at myomectomy	Randomized controlled trial	Twenty women with symptomatic uterine fibroids scheduled for myomectomy which separated into 2 groups: 10 randomized for the vasopressin group and 10 for the control group	The use of vasopressin resulted in a median blood loss of 225 ml (range 150–400 mL) compared with 675 mL (range 500–800 mL) in the placebo group ($p < 0.001$).	The use of vasopressin is effective in preventing blood loss and reducing the need for blood transfusion	2b
Taylor et al., [14]	To evaluate triple tourniquets for reducing post-operative bleeding on patients undergoing uterine incisions.	Randomized controlled trial	28 patients with symptomatic fibroids and uterine undergoing open myomectomy	Tourniquet group shows significantly less blood loss than the control group, the estimated blood loss resulted in 489 mL and 2359 mL, respectively. ($p < 0.0001$)	Triple tourniquets are effective in reducing bleeding and transfusion rates.	2b
Kathiresan et al., [15]	To compare blood loss and need for blood transfusions in women who underwent abdominal myomectomies after receiving vasopressin or combined vasopressin and tourniquet	A retrospective comparison of prospectively collected data	Women between the ages of 20 and 50 years old who underwent abdominal myomectomies were divided into three groups: No intervention, vasopressin, or combined vasopressin and tourniquet.	Combined group shows lower result of estimated blood loss (319.8 ± 295.8) than the vasopressin-only group (509.5 ± 432.1).	Combined vasopressin and tourniquets were not associated with a statistically significant decrease in blood loss or need for blood transfusion.	3b

blood loss. Uterine blood loss occurs by improving vascularity and preventing the recurrence of visible masses [6]. Hemostasis is essential for the success of the procedure and recovery of the patients at the time of intervention surgery [6].

Several techniques have been used to reduce blood loss during surgery. Intra-myometrial administration of vasopressin has reduced blood

loss significantly [7]. The use of tourniquets during myomectomy has also significantly reduced intra-operative blood loss and post-operative morbidity [7].

In addition, previous RCT studies that compared the group to placebo obtained less blood loss with vasopressin than with placebo. Vasopressin causes vasoconstriction through V1 receptors in the myometrium, reducing blood loss [6]. Vasopressin

administration during myomectomy is a useful pharmaceutical strategy to stop bleeding [6]. Saha *et al.* found that the use of vasopressin resulted in less intra-operative blood loss than the tourniquet group and required less blood transfusion [6]. The study also concurred a lower fall in hemoglobin levels and hematocrit values in the vasopressin group compared with the tourniquet group [6].

A remarkable finding from Protopapas *et al.*, demonstrated that the lack of vasoconstriction was related to higher transient hypercapnia rates [10]. This event may occur in repeated interruptions and prolong operative duration, especially in cases with large, deep, multiple myomas, and the enucleation of which leaves extensive open venous sinuses that cause rapid absorption of CO₂ [10].

Controlling hemorrhage with intra-myometrial vasopressin reduces the need for blood transfusions [6]. Frederick *et al.* found that patients in the vasopressin group did not require blood transfusion during myomectomy; Hence, the use of vasopressin during myomectomy minimizes blood loss, which in theory decreases post-operative mortality [5], [16].

Despite the efficacious effects, the use of intra-myometrial vasopressin may be contraindicated in women with comorbidities such as vascular, cardiovascular, or renal diseases [17]. Systematic guidelines are required, including safe dosing of intra-myometrial vasopressin [17]. Coordination between the anesthesiologist and gynecologist is vital to prevent, determine, and handle the complications due to intra-myometrial vasopressin [17].

The uterus' blood supply is primarily from the uterine arteries, which pass through the cardinal ligament at the cervicouterine junction level, and secondarily from the ovarian arteries [18], [19]. The purpose of the tourniquet application is to occlude the blood supply to the uterus temporarily and, consequently, to the fibroid, reducing the lesion's vascularity [18]. The tourniquet is the cheapest and most accessible for our environment by far [18], [20]. Bonney's clamp is not universally available; vasopressin is scarce and may predispose to severe complications such as pulmonary edema, myocardial infarction, and severe hypertension [20]. GnRH analogs are expensive and are associated with menopausal side effects with prolonged use. Although they reduce the fibroid masses' size, they have been shown not to affect blood loss during surgery [20]. Besides, they cause a blurring of the pseudo-capsule planes and subsequently make shelling of the mass difficult, and the smaller masses disappear before surgery only to regrow on cessation of the treatment [20].

The Foley catheter form of the tourniquet used in the study conducted by Ikechebelu *et al.*, is beneficial with a significant reduction in blood loss among the tourniquet group compared to the no-tourniquet

group [20]. Similarly, Kongnuyi and Wiysonge found a significant reduction in blood loss with tourniquet usage. This reduction in blood loss reasonably suggests a reduction in the need for blood transfusion [20]. Ikechebelu *et al.*, demonstrated a significantly lower blood transfusion rate among the tourniquet group [20]. Considering the intrinsic dangers of blood transfusion, methods that limit the necessity for blood transfusions should be encouraged, and a tourniquet at myomectomy is one of them [20]. A clear operating field is another crucial advantage gained from the tourniquet and is a cardinal principle of surgery particularly appropriate for myomectomies. This advantage will allow the removal of virtually every visible piece of fibroid and may reduce operating time [20].

Once the tourniquets are tightened in place, the myomectomy should proceed expeditiously to prevent ischemic damage to the uterus, tubes, and ovaries due to prolonged devascularization [18]. The length of time the pelvic structures can be without blood flow before irreversible damage occurs is unknown [18]. However, due to the existing potential for injury, tourniquet time should be monitored and kept to a minimum [18]. The tourniquets were not tightened until the surgical team was ready to perform the myomectomy [18]. However, the tourniquet cannot be used in patients with large cervical or intra-ligamentary fibroids (unless such placed fibroid is first removed) and has to be released intermittently to prevent toxic buildup [18].

Intra-myometrial vasopressin administration is an effective method to control hemorrhage and the necessity of blood transfusion. Saha *et al.* observed that the vasopressin group required less blood transfusion [6]. The use of a tourniquet over uterine arteries also decreases intra-operative blood loss, operation time, and the need for blood transfusion [6]. However, vasopressin's advantages over the tourniquet are without risk of any ischemic damage to the uterus and thromboembolism [6].

Fletcher *et al.*, found that vasopressin is better than tourniquet at reducing blood loss but did not interfere with blood transfusion [4]. Nevertheless, more of the tourniquet subjects had severe blood loss (more than 1 L) [4]. The possible reason for more blood loss in the tourniquet group reflects the tourniquet being released every 20 min or the tourniquet's placement around the lower part of the uterus can only occlude the uterine vessels. In contrast, the injection of vasopressin causes vascular spasms of the uterine vessels and branches of vessels from the ovarian ligament anastomosis, which can supply a substantial amount of blood to an enlarged uterus [4]. Others recommend the placement of the tourniquet around the infundibulopelvic ligaments (ie, the ovarian vessels) as well as the uterine vessels to avoid excessive bleeding [4]. However, Fletcher *et al.*, discovered a lack of significant differences in the post-operative patient profile despite the differences between blood loss [4].

Ginsburg *et al.*, found no significant difference between vasopressin and tourniquets in blood loss, operative time, blood transfusion requirements, and post-operative morbidity [9]. However, Ginsburg *et al.*, observed that diluted vasopressin is significant and may be easier to use in patients whose fibroids are primarily in subserosal locations with little intra-myometrial extension [9]. In cases with large uteri carrying multiple or large deep intramural fibroids, the use of the uterine tourniquet and vascular clamps may be quite useful [9].

Despite the trend toward lower blood loss and fewer perioperative blood transfusions in the combination group, Kathiresan *et al.*, found that the association was insignificant and remains unconfirmed by a retrospective study [15]. With a larger sample size, the differences between groups might have addressed statistical significance [15]. These results may promote the use of combined vasopressin and tourniquets for better hemostasis during myomectomies and decreased need for blood transfusions [15], [16].

Conclusion

The utilization of hemostatic agents shows a more beneficial outcome for patients undergoing myomectomy. Both the injection of a hormonal agent (vasopressin) and mechanical technique (tourniquet) gave a significant result in reducing the EBL volume. However, the application of both agents simultaneously failed to exhibit lower blood loss. Due to its high efficacy and minimum adverse effect, both agents also show a promising result in lesser morbidity as a hemostatic agent in the myomectomy.

Recommendation

We hope that the analysis of the effectiveness of vasopressin and tourniquet in this systematic study can be the basis for this treatment's continuity. For patients, this study is expected to enhance patients' confidence and knowledge to understand the effectiveness and safety of vasopressin and tourniquet in myomectomy. For health-care providers, this study is expected to provide a comprehensive picture and solution regarding the comparison of vasopressin and tourniquet. For the community and government, this study is expected to motivate more RCTs to be conducted regarding these interventions to reduce blood loss in myomectomy.

Vasopressin and tourniquet both can significantly decrease intra-operative blood loss. However, the more effective hemostatic agent was still unknown, and more randomized clinical trials would be required to determine which approach is best. Conclusively, randomized controlled studies on this topic are limited and have shown differing results. There

is a need for adequately powered RCTs with larger samples to enlighten the effectiveness and safety of vasopressin and tourniquet to reduce blood loss during myomectomy.

References

1. Barjon K, Mikhail LN. Uterine leiomyomata (fibroids). In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2020. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK546680> [Last accessed on 2020 Oct 16].
2. Williams AR. Uterine fibroids – what's new? F1000Res. 2017;6:2109. <https://doi.org/10.12688/f1000research.12172.1> PMID:29259779
3. Tanos V, Berry KE, Frist M, Campo R, DeWilde RL. Prevention and management of complications in laparoscopic myomectomy. Biomed Res Int. 2018;2018:8250952. <https://doi.org/10.1155/2018/8250952> PMID:29693017
4. Fletcher H, Frederick J, Hardie M, Simeon D. A randomized comparison of vasopressin and tourniquet as hemostatic agents during myomectomy. Obstet Gynecol. 1996;87(6):1014-8. [https://doi.org/10.1016/0029-7844\(96\)00071-3](https://doi.org/10.1016/0029-7844(96)00071-3) PMID:8649682
5. Frederick J, Fletcher H, Simeon D, Mullings A, Hardie M. Intramyometrial vasopressin as a haemostatic agent during myomectomy. Br Int J Obstet Gynaecol. 1994;101(5):435-7. <https://doi.org/10.1111/j.1471-0528.1994.tb11918.x> PMID: 8018617
6. Saha MM, Khushboo, Biswas SC, Alam H, Kamilya GS, Mukhopadhyay M, *et al.* Assessment of blood loss in abdominal myomectomy by intramyometrial vasopressin administration versus conventional tourniquet application. J Clin Diagn Res. 2016;10(5):QC10-3. <https://doi.org/10.7860/JCDR/2016/17484.7789> PMID:27437308
7. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. BMJ 2009;339:b2535. <https://doi.org/10.1136/bmj.b2535> PMID:19622551
8. Phillips B, Ball C, Sackett D, Badenoch D, Straus S, Haynes B, *et al.* Oxford Centre for Evidence-Based Medicine: Levels of Evidence (March 2009). Oxford: Centre for Evidence-Based Medicine (CEBM); 1998. Available from: <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009> [Last accessed on 2020 Oct 17].
9. Ginsburg ES, Benson CB, Garfield JM, Gleason RE, Friedman AJ. The effect of operative technique and uterine size on blood loss during myomectomy: A prospective randomized study. Fertil Steril. 1993;60(6):956-62. [https://doi.org/10.1016/s0015-0282\(16\)56392-4](https://doi.org/10.1016/s0015-0282(16)56392-4) PMID:8243699
10. Protopapas A, Giannoulis G, Chatzipapas I, Athanasiou S, Grigoriadis T, Kathopoulos N, *et al.* Vasopressin during laparoscopic myomectomy: Does it really extend its limits? J Minim Invasive Gynecol. 2018;26(3):441-9. <https://doi.org/10.1016/j.jmig.2018.05.011> PMID:29778690
11. Sapmaz E, Çelik H. Comparison of the effects of the ligation of

- ascending branches of bilateral arteria uterina with tourniquet method on the intra-operative and post-operative hemorrhage in abdominal myomectomy cases. *Eur J Obstet Gynecol Reprod Biol.* 2003;111(1):74-7. [https://doi.org/10.1016/s0301-2115\(03\)00207-0](https://doi.org/10.1016/s0301-2115(03)00207-0)
PMid:14557016
12. Dillon TF. Vasopressin as a hemostatic in gynecologic surgery. *Am J Obstet Gynecol.* 1959;78(6):1285-91. [https://doi.org/10.1016/0002-9378\(59\)90591-5](https://doi.org/10.1016/0002-9378(59)90591-5)
PMid:13816786
13. Cohen SL, Senapati S, Gargiulo AR, Srouji SS, Tu FF, Solnik J, *et al.* Dilute versus concentrated vasopressin administration during laparoscopic myomectomy: A randomised controlled trial. *BJOG.* 2016;124(2):262-8. <https://doi.org/10.1111/1471-0528.14179>
PMid:27362908
14. Taylor A, Sharma M, Tsirkas P, Di Spiezio Sardo A, Setchell M, Magos A. Reducing blood loss at open myomectomy using triple tourniquets: A randomised controlled trial. *BJOG.* 2005;112(3):340-5. <https://doi.org/10.1111/j.1471-0528.2004.00430.x>
PMid:15713151
15. Kathiresan AS, Brookfield KF, Gonzalez-Quintero VH, Verma U. Vasopressin versus a combination of vasopressin and tourniquets: A comparison of blood loss in patients undergoing abdominal myomectomies. *Aust N Z J Obstet Gynaecol.* 2010;51(1):79-83. <https://doi.org/10.1111/j.1479-828x.2010.01253.x>
PMid:21299514
16. Agida ET, Isah AD, Isah AY. Intramyometrial vasopressin for reducing blood loss at myomectomy. *Ann Med Health Sci Res.* 2020;10:857-64.
17. Chilkoti G, Mohta M, Nath S, Saxena AK, Khurana P. Anaesthetic concerns with intramyometrial vasopressin during myomectomy. *Ain-Shams J Anaesthesiol.* 2016;9:452-4. <https://doi.org/10.4103/1687-7934.189089>
18. Sanyal U, Ghosh S, Hiremath PB, Hiremath R. The role of tourniquet in myomectomy: An observational study. *Int J Reprod Contracept Obstet Gynecol.* 2019;8(4):1610-5. <https://doi.org/10.18203/2320-1770.ijrcog20191227>
19. Kongnyuy EJ, van den Broek N, Wiysongse CS. A systematic review of randomized controlled trials to reduce hemorrhage during myomectomy for uterine fibroids. *Int J Gynecol Obstet.* 2007;100(1):4-9. <https://doi.org/10.1016/j.ijgo.2007.05.050>
PMid:17894936
20. Ikechebelu JI, Eczema CO, Obiechina NJ. The use of tourniquet to reduce blood loss at myomectomy. *Niger J Clin Pract.* 2010;13(2):154-8.
PMid:20499747