Local Epinephrine Versus Uterine Artery Tourniquet to Reduce Bleeding During Myomectomy: A Prospective Clinical Trial

Original Article

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ABSTRACT

Objective: Despite the availability of interventions for controlling bleeding during myomectomy, the superiority of one over another is still unclear.

Materials and Methods: This prospective study was conducted at Mansoura University Hospital, Mansoura, Egypt, between July 2019 and July 2021, after approval from the Mansoura Faculty of Medicine Institutional Research Board (IRB: MS.19.05.629) on 40 cases divided into two equal groups. Patients in the tourniquet group: A Foley catheter of 16F size surrounded the cervix at the level of the internal os and tightened to occlude the uterine arteries. The epinephrine group: a solution of 1/250,000 epinephrine)produced by dilution of 1 ampule epinephrine(1mg/1ml Epinephrine: chemical industries development (CID), Giza, Egypt) in 250 ml saline(was infiltrated at the myoma bed and beneath the covering myometrium until the infiltrated areas became paler.

Results: The blood loss was significantly lower in the epinephrine group (362.50± 61.12) versus (452.95± 70.72) ($p < 0.001$). Blood transfusion was non significantly higher in the tourniquet group (55%) versus (25%) ($p = 0.053$). The operative time was considerably shorter ($p < 0.001$) in the epinephrine group (36.65±4.38) compared with the tourniquet group (41.65±3.77). The hospital stay wasn't statistically longer in the tourniquet group compared to the epinephrine group (2(1-3)) (1(1-2)) respectively, ($p = 0.147$. Fortunately, no cases of hysterectomy or relaparotomy in both groups.

Conclusion: Injecting Epinephrine during myomectomy reduces intraoperative blood loss and blood transfusion and shortens the operative time.

Key Words: Blood loss, epinephrine, myomectomy, tourniquet.

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INTRODUCTION

Uterine myomas are a common benign neoplasm of the female genital tract and may indicate a hysterectomy. Although hysterectomy is the myomas' definitive treatment, myomectomy remains the 'gold-standard' treatment for women desiring to keep their fertility[1].

Bleeding is often a problem during myomectomy and can result in intra-operative hypovolemia, postoperative anaemia and delayed recovery[2].

Many interventions have been introduced to reduce bleeding during myomectomy, such as vascular intervention on uterine and ovarian arteries, like clamping, tying (tourniquet) or embolisation. The pharmacological trials used vasopressin, oxytocin, ergometrine, misoprostol, or gonadotropin-releasing hormone (GnRH) agonists to control bleeding[3–12].

Local injection of vasopressin causes vasospasm and reduces blood loss; however, it is associated with cardiovascular complications like bradycardia, arrhythmias, pulmonary oedema and cardiac arrest[13–16].

Epinephrine also induces a vasoconstrictive effect on tissues and has been used during various gynaecological operations and endoscopic resections to reduce blood loss. However, the use of Epinephrine during myomectomy is still limited since most gynaecologists use vasopressin more[2,17–19].

The tourniquet in uterine surgery interrupts the blood supply to the uterus by compressing the main feeding vessels. However, some uterine myomas, like cervical and broad ligament myomas, may disturb the normal anatomy of the uterus[20], making the tourniquet inapplicable. A tourniquet may be applied around the cervix to occlude both uterine arteries, while in the triple tourniquet, the ovarian vessels are blocked lateral to the ovaries[6,12,18,21].

This prospective study aims to compare the traditional tourniquet to local infiltration of Epinephrine to reduce

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blood loss during open myomectomy in Mansoura university hospital.

MATERIALS AND METHODS

This prospective study was carried out in Mansoura University Hospital, Mansoura, Egypt, on 40 patients, between July 2019 and July 2021, after approval from the institutional research committee (IRB: MS.19.05.629), as the clinical part of the master's degree, faculty of medicine, Mansoura University of the 1st author. It was planned to be a randomised study, but the randomisation was breached, and the allocation to groups was by case order.

All women in the study should not have bleeding tendencies, liver, renal, heart disease, or current or previous malignancies. They did not have pelvic surgery before, except for cesarean deliveries. Women with a history of pelvic endometriosis, pelvic inflammatory disease or recurrent myomas were excluded from the study.

For all women included in the study, written informed consent was taken after a detailed oral discussion about the procedure and the possible complications.

Thorough history taking, general physical examination, local gynaecological examination, and pelvic and abdominal ultrasound evaluation were made for all participants to assess uterine fibroids regarding their site, number, volume and associated pathology. All necessary preoperative laboratory investigations were done with preoperative complete blood count, liver and kidney function tests, coagulation profile, and electrocardiogram.

All women were given general anaesthesia with endotracheal intubation using isoflurane inhalation anaesthesia. Warm saline 0.9% will be infused at a rate of 8ml/ kg to replenish the overnight fasting hours for all patients and to keep the CVP> 5mmhg. A central venous catheter was inserted just before surgery to judge the status of the intravascular volume and hemodynamics using a single-lumen catheter (Amecath, France). The catheter was inserted in the right internal jugular vein with a strict sterile technique using the Sildnenger technique after local infiltration of Lidocaine 2%. The catheter was flushed with normal heparinised saline and connected to a pressure transducer for CVP monitoring.

The skin incision was either Pfannenstiel or midline sub-umbilical according to the uterine size and accessibility. Meticulous hemostasis was carried out while opening the abdomen. The first blood sample will be taken after opening the abdomen to exclude the effect of parietal blood loss.

In the tourniquet group: a Foley catheter 16F size was put surrounding the cervix at the level of the internal os, tightened to occlude the uterine arteries and kept tight using an artery clamp. The maximum time for occlusion will be 20 minutes, calculated by an observing house officer with a stopwatch. In prolonged operations, the tourniquet will be released after 20 minutes for 5 minutes and then reapplied again to avoid tissue ischemia.

In the epinephrine group: a solution of 1/250,000 epinephrine produced by dilution of 1 ampule epinephrine (1mg/1ml Epinephrine: chemical industries development (CID), Giza, Egypt) in 250 ml saline and infiltration at the myoma bed and beneath the covering myometrium will be done until the infiltrated areas become paler.

A myomectomy was done, and uterine incisions were closed with polyglycolic acid number 0 on a round needle occluding the myoma beds carefully. The suction apparatus worked only with uterine incision and closed immediately after the uterine haemostasis. The towels used only during the uterine procedure were counted and weighed before (empty towels) and after use (soaked towels). The estimated blood loss was calculated from the suction container and the difference in weights of the towels (soaked weight -empty weight).

The second postoperative blood sample was taken after closing the skin of the abdomen. The intravenous fluid arm was avoided when taking blood samples.

The primary outcome was assessing the blood loss, comparing the pre-and postoperative haemoglobin concentrations and hematocrit percentage, and Operative time. The need for blood transfusion, hospital stay, hysterectomies, anaesthetic complications, complications related to Epinephrine and Reoperation will be considered.

Statistical analysis

Data were analysed using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 26). Qualitative data were described using numbers and percentages. Association between categorical variables was tested using the Chi-square test, while the Monte Carlo test and Fisher exact test were used when the expected cell count was less than 5. Continuous variables were presented as mean ± SD (standard deviation) for normally distributed data and median (min-max) for non-normal data. The two groups were compared with the Student t-test for parametric data and the Mann-Whitney test for non-parametric data. ANOVA test was used to compare more than two means, and Pearson correlation was used to correlate quantitative data.

For all the statistical tests mentioned above, the significance threshold is fixed at a 5% level. The results were considered significant when $p \leq 0.05$. The smaller the *p-value* obtained, the more significant the results.

RESULTS

This study was conducted on 40 patients, twenty in each group. Patients' demographic data Show no significant difference between the two groups regarding age, gravidity, parity, miscarriage rate, and body mass index ($p > 0.05$) (Table 1).

There was no significant difference between the number of fibroids (p= 0.075), the anatomical type of fibroids in the two groups (p = 0.08) and uterine volume in the two groups (p =0.193) (Table 2).

Table 1: Sociodemographic data and obstetric history among the studied groups

Sociodemographic data & obstetric history	Local Epinephrine (n=20)	Uterine Artery Tourniquet (n=20)	Test of significance	*P value*
Age (years)				
Mean ± SD	32.75±4.16	33.20±4.47	t=0.329	0.744
Min-Max	25-41	25-41		
Gravidity				
Null gravida	10 (50.0%)	11 (55.0%)	MC	1.0
Prim gravida	7 (35.0%)	6 (30.0%)		
Gravida 2	3 (15.0%)	3 (15.0%)		
Parity				
Null para	13 (65.0%)	12 (60.0%)	MC	1.0
Prim Para	6 (30.0%)	7 (35.0%)		
Para 2	1 (5.0%)	1 (5.0%)		
Abortion				
Yes	5 (25.0%)	3 (15.0%)	FET	0.695
No	15 (75.0%)	17 (85.0%)		
BMI				
Mean ± SD	28.38± 2.98	28.32± 2.68	t=0.061	0.951

t: Independent t-test, MC: Monte Carlo test, FET: Fisher exact test

Table 2: Number of fibroids and anatomical type of fibroids among studied groups

Number of fibroids and FIGO type	Local Epinephrine (n=20)	Uterine Artery Tourniquet (n=20)	*P value*
Number of fibroids			
1	6 (30.0%)	1 (5.0%)	0.075
2	10 (50.0%)	16 (80.0%)	
3	4 (20.0%)	3 (15.0%)	
NO. and FIGOType			
Single: FIGO (Hybrid)	4 (20.0%)	1 (5.0%)	
Single: FIGO (SM)	1 (5.0%)	0 (0%)	
Single: FIGO (O)	1 (5.0%)	0 (0%)	
Two: FIGO (SM), FIGO (O)	٢) ٥5.0%)	6 (30.0%)	0.08
Two: FIGO (SM), FIGO (Hybrid)	2 (10.0%)	2 (10.0%)	
Two: FGO (Hybrid), FIGO(O)	2 (10.0%)	2 (10.0%)	
Two: FIGO (SM), FIGO (O)	1 (5.0%)	6 (30.0%)	
Three: FIGO (SM), FIGO (O), FIGO (O)	٤ (20.0%)	3 (15.0%)	
Uterine volume (cc)	248.79± 68.46	275.32± 57.66	0.193

The Monte Carlo test was used

FIGO(SM): submucosal (0,1,2)

FIGO(O): others (3-8), but we don't have cases FIGO 7 or 8

FIGO (Hybrid): 2-5

Blood loss was significantly lower in the epinephrine group than in the tourniquet group (362.50± 61.12) versus (452.95± 70.72) ($p < 0.001$), respectively. The Soaked towel numbers were significantly less in the epinephrine group in comparison to the tourniquet group (p =0.004) (3.45± 0.68) versus (4.20 ± 0.83), respectively (Table 3).

The postoperative haemoglobin level in the epinephrine group compared with the tourniquet group was 10.32± 084 versus 10.25±0.83, respectively; the difference was still insignificant ($p = 0.808$). The Postoperative hematocrit level is significantly higher in the epinephrine group in comparison to the tourniquet group (p =0.02) (31.15±0.84) versus (30.39± 1.10), respectively. Blood transfusion in the epinephrine group compared with the tourniquet group was (25%) versus (55%), respectively, but the difference was not significant ($p = 0.053$) (Table 3).

The operative time was significantly shorter in the epinephrine group compared with the tourniquet group (p < 0.001) (36.65± 4.38) versus (41.65 ±3.77) (Table 3)).

The hospital stay was longer in the tourniquet group (2 days (1-3)) compared to (1(1-2)) in the epinephrine group, but the difference wasn't statistically significant ($p = 0.147$. (Table 4). Fortunately, no cases of hysterectomy or relaparotomy in both groups (Table 4).

A significant positive correlation was observed between the number of fibroids, anatomical type of fibroids and the operative time in the epinephrine group compared with the tourniquet group ($p < 0.001$) versus ($p = 0.993$) respectively, (Table 6) for fibroid numbers, ($p < 0.001$) versus ($p = 0.256$) for the anatomical type (Tables 5,6).

Table 3: blood loss, Hemoglobin level, and Hematocrit level preoperative and postoperative among studied groups

Haemoglobin	Local Epinephrine (n=20)	Uterine Artery Tourniquet (n=20)	Test of significance	*P value*
Blood loss (cc)	362.50±61.12	452.95±70.72	t=4.33	≤0.001*
Soaked towels no.	3.45± 0.68	4.20± 0.83	t=3.11	0.004*
Hemoglobin preop Mean ± SD	11.71± 0.51	11.91± 0.31	t=1.41	0.167
Hematocrit pre Mean ± SD	33.81± 0.82	33.46± 0.57	t=1.57	0.124
Hemoglobin post Mean ± SD	10.32± 0.84	10.25± 0.83	t=0.245	0.808
Hematocrit post Mean ± SD	31.15±0.84	30.39±1.10	t=2.43	0.02*
Blood transfusion Yes No	5 (25.0%) 15 (75.0%)	11 (55.0%) 9 (45.0%)	χ^2=3.75	0.053
Operative time (min.)	36.65± 4.38	41.65± 3.77	t=3.87	≤0.001*

*significant $p \leq 0.05$

Table 4: Postoperative complications and hospital stay among studied groups

Postoperative complications	Local Epinephrine (n=20)	Uterine Artery Tourniquet (n=20)	Test of significance	*P value*
Blood transfusion Yes No	5 (25.0%) 15 (75.0%)	11 (55.0%) 9 (45.0%)	χ^2=3.75	0.053
Hysterectomy Yes No	0 (0%) 20 (100%)	0 (0%) 20 (100%)	-	-
Reoperation Yes No	0 (0%) 20 (100%)	0 (0%) 20 (100%)	-	-
Hospital stay Median (Min-Max)	1 (1-2)	2 (1-3)	Z=1.45	0.147

χ^2: chi-square test, Z: Mann Whitney test

Table 5: Correlation between the number of fibroids and operative time (min.)

	Number of fibroids			
	Local Epinephrine		Uterine Artery Tourniquet	
	r	*P value*	r	*P value*
Operative time (min.)	0.742	≤0.001*	0.002	0.993

Table 6: Relation between the anatomical type of fibroids and operative time (min.)

Type of fibroids	Operative time (min.)				P#
	Local Epinephrine	P value	Uterine Artery Tourniquet	*P value*	
Single: FIGO (Hybrid)	33.00±1.41	≤0.001*	37.00±0.0	0.256	0.058
Single: FIGO (SM)	30.00±0.0		-		-
Single: FIGO (O)	30.00±0.0		-		-
Two: FIGO (SM), FIGO (O)	38.00±2.16		42.66±3.32		0.011*
Two: FIGO (SM), FIGO (Hybrid)	35.00±4.24		46.00±5.65		0.159
Two: FGO (Hybrid), FIGO(O)	44.00±1.41		38.50±4.94		0.270
Two: FIGO (SM), FIGO (O)	35.00±0.0		41.83±3.43		0.124
Three: FIGO (SM), FIGO (O), FIGO (O)	41.00±1.41		40.00±1.73		0.550

P#: Compare Local Epinephrine and Uterine Artery Tourniquet groups

The anatomical types of fibroids and the blood loss were also positively correlated and were much less in the epinephrine group compared with the tourniquet group (p =0.006) versus (p = 0.314) (Table 7).

Table 7: Relation between the number and anatomical type of fibroids and blood loss (cc)

Number and type of fibroids	Blood loss (cc)				P#
	Local Epinephrine	*P value*	Uterine Artery Tourniquet	*P value*	
Single: FIGO (Hybrid)	322.50±32.01		330.00±0.0		0.847
Single: FIGO (SM)	320.00±0.0		-		-
Single: FIGO (O)	290.00±0.0		-		-
Two: FIGO (SM), FIGO (O)	362.85±39.46	0.006*	476.66±79.91	0.314	0.007*
Two: FIGO (SM), FIGO (Hybrid)	345.00±7.07		505.00±21.21		0.01*
Two: FGO (Hybrid), FIGO(O)	420.00±70.71		399.50±55.86		0.778
Two: FIGO (SM), FIGO (O)	310.00±0.0		445.00±67.45		0.123
Three: FIGO (SM), FIGO (O), FIGO (O)	485.00±7.07		463.33±56.86		0.646

DISCUSSION

Our study has shown no significant difference in blood transfusion or hospital stay duration between the tourniquet and epinephrine groups. At the same time, there was a significant reduction in intraoperative blood loss and operative time.

The tourniquet is not an option in broad ligament myoma, cervical fibroid, laparoscopic or robotic myomectomy; the vasoconstrictive agents and uterine artery ligations are alternatives. The tourniquet may be slipped or rupture, leading to severe bleeding and more time required for retightening or applying another.

Uterine artery occlusion may transiently decrease the antral follicle count, ovarian volume and stromal blood flow in 3 months and recover in 6 months. However, it had no detrimental effect on ovarian reserve six months postoperatively based on anti-mullerian hormone and FSH levels[22].

In the current study, there were no statistically significant differences between the two groups regarding age, BMI, gravidities, parities, and a number of previous abortions.

Nearly half of the cases within the two study groups were nulligravida, and more than half of the patients were nullipara. These findings agreed with the studies of Laughlin & Schroeder and Bray & Torstenson, who confirmed that Parity had been inversely associated with a risk of fibroid development[23,24].

There are three types of leiomyomas: intramural (most common), subserosal and submucosal[25,26]; in the current study, the most common type of myomas was the submucosal-intramural type and was detected in 25% and 30% in the epinephrine and tourniquet groups respectively.

Compared to the placebo or tourniquet, vasoconstrictive agents like Epinephrine and Vasopressin reported significantly decreased bleeding and operative time[17,18,21,27,28].

Our mean operative time was significantly shorter (p < 0.001); this agreed with Abouzeid *et al*. and Agameya *et al*. studies[17,29]. The shorter operative time may be due to the better haemostasis and better line of demarcation, which facilitate enucleation and rapid closure in the epinephrine group.

The pressure exerted by the tourniquet may cause damage to the uterine artery and its branches and temporarily mask inadequate haemostasis, which only becomes apparent once the tourniquet is removed[18].

The reported blood loss for vasoconstrictive is less during laparoscopic myomectomy; it may be attributed to the difference in the operation technique, gas pressure, and smaller tumour mass volume of fibroids selected for laparoscopic myomectomy[30].

In the current study, no cases required a hysterectomy or reoperation; however, relaparotomy for managing haematomas with a tourniquet has been reported. Darwish *et al*. stated that tourniquet is frequently associated with haematoma formation and recommended against it during myomectomy[31].

The strength points of this study are being conducted in one centre with the same expertise, different types of myoma and different sizes. The study was conducted on nulliparous and multiparous women.

The main limitations of the current study are the small sample size, absence of randomisation and being a single-centre study. Also, this study didn't assess the effect of Epinephrine on hemodynamic parameters such as heart rate and blood pressure.

CONCLUSION

Intra-myometrial injection of Epinephrine at myomectomy may be a valid alternative to tourniquet application. A properly conducted multicentric trial with an appropriate sample size may be needed to recommend this approach.

Patient consent

There was written permission before participation, including the study's publication, and IRB approved the consent items.

ETHICAL APPROVAL

This study was approved on 4/7/2019 by the Mansoura Faculty of Medicine Institutional Research Board (irb.mfm@hotmail.com +201092127930) as the clinical part of the master's degree, faculty of medicine, Mansoura University of the 1st author. The IRB no. of this study is (IRB: MS.19.05.629).

CONTRIBUTIONS

Sally khashba: developing the protocol, collecting the data, consenting patients, doing statistics and writing up.

Osama Warda: the principal supervisor of the master's degree, conducting the operation, participating in writing and critical appraisal of the manuscript

Ahmed Gibrel: running the operation, critical appraisal of manuscript, participation in writing

Maher Elesawi Elgaly: drafting the protocol, running the operation, writing up the manuscript, correspondence

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CONFLICT OF INTERESTS

There are no conflicts of interest.

REFERENCES

1. Wang Y, Geng J, Bao H, Dong J, Shi J, Xi Q. Comparative Effectiveness and Safety of High-Intensity Focused Ultrasound for Uterine Fibroids: A Systematic Review and Meta-Analysis. Front Oncol. 2021;11(March).
2. Song T, Kim MK, Kim ML, Jung YW, Yun BS, Seong SJ. Use of vasopressin vs Epinephrine to reduce haemorrhage during myomectomy: a randomized controlled trial. Eur J Obstet Gynecol Reprod Biol. 2015 Dec 1;195:177–81.
3. Bedaiwy MA. Uterine artery occlusion at myomectomy? Toward a better definition of the indications. Fertil Steril. 2019 Apr 1;111(4):685–6.
4. Leone Roberti Maggiore U, Scala C, Venturini PL, Ferrero S. Preoperative treatment with letrozole in patients undergoing laparoscopic myomectomy of large uterine myomas: A prospective non-randomized study. Eur J Obstet Gynecol Reprod Biol. 2014 Oct 1;181:157–62.
5. Srivastava S, Mahey R, Kachhawa G, Bhatla N, Upadhyay AD, Kriplani A. Comparison of intramyometrial vasopressin plus rectal misoprostol with intramyometrial vasopressin alone to decrease blood loss during laparoscopic myomectomy: Randomized clinical trial. Eur J Obstet Gynecol Reprod Biol. 2018 Sep 1;228:279–83.
6. 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 An Int J Obstet Gynaecol. 2005 Mar;112(3):340–5.
7. Frederick S, Frederick J, Fletcher H, Reid M, Hardie M, Gardner W. A trial comparing the use of rectal misoprostol plus perivascular vasopressin with perivascular vasopressin alone to decrease myometrial bleeding at the time of abdominal myomectomy. Fertil Steril. 2013 Oct;100(4):1044–9.
8. Delli Carpini G, Morini S, Tsiroglou D, Verdecchia V, Montanari M, Donati V, *et al*. Factors influencing intraoperative blood loss and hemoglobin drop during laparoscopic myomectomy: a tailored approach is possible? J Obstet Gynaecol (Lahore). 2021;
9. Samy A, Raslan AN, Talaat B, El Lithy A, El Sharkawy M, Sharaf MF, *et al*. Perioperative nonhormonal pharmacological interventions for bleeding reduction during open and minimally invasive myomectomy: a systematic review and network meta-analysis. Fertil Steril. 2020 Jan 1;113(1):224-233.e6.
10. Protopapas A, Kathopoulis N, Chatzipapas I, Athanasiou S, Grigoriadis T, Samartzis K, *et al*. Misoprostol vs vasopressin as a single hemostatic agent in laparoscopic myomectomy: Comparable, or just better than nothing? J Obstet Gynaecol Res. 2020 Nov 1;46(11):2356–65.
11. Protopapas A, Giannoulis G, Chatzipapas I, Athanasiou S, Grigoriadis T, Kathopoulis N, *et al*. Vasopressin during Laparoscopic Myomectomy: Does It Really Extend Its Limits? J Minim Invasive Gynecol. 2019 Mar 1;26(3):441–9.
12. 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.
13. Byrne H, Miskry T, Gomez CMH. Using vasopressin for myomectomy. Obstet Gynecol. 2009 Jul;114(1):169–70.
14. Hobo R, Netsu S, Koyasu Y, Tsutsumi O. Bradycardia and cardiac arrest caused by intramyometrial injection of vasopressin during a laparoscopically assisted myomectomy. Obstet Gynecol [Internet]. 2009 Feb [cited 2022 Aug 9];113(2 PART 2):484–6. Available from: https://journals.lww.com/greenjournal/Fulltext/2009/02001/Bradycardia_and_Cardiac_Arrest_Caused_by.5.aspx
15. Di Francesco L, Javadian P, Nezhat F, Nezhat C. Laparoscopic Myomectomy vs Laparoscopically Assisted Myomectomy by Minilaparotomy: A Retrospective Study [8D]. Obstet Gynecol. 2018 May;131(1):43S-43S.

16. Soliman R. Assessment of the perioperative effect of vasopressin in patients undergoing laparoscopic myomectomy: A double-blind randomised studyle). Indian J Anaesth [Internet]. 2021;65(2):139–145. Available from: www.ijaweb.org

17. abouzeid ziad. Effect of intramyometrial injection of Epinephrine during abdominal myomectomy. Evid Based Women's Heal J. 2021;0(0):0–0.

18. Kongnyuy EJ, Wiysonge CS. Interventions to reduce haemorrhage during myomectomy for fibroids. Cochrane Database Syst Rev [Internet]. 2014 Aug 15 [cited 2022 Jul 1];2014(8). Available from: /pmc/articles/PMC9017065/

19. Mansour-Ghanaei M, Fatemeh Hosseinzadeh |, Seyedeh |, Sharami H, Gelareh Biazar |, Noori | Fatemeh, *et al*. Safety and efficacy of lidocaine plus epinephrine on intraoperative bleeding in abdominal myomectomy: A double-blind clinical trial. Heal Sci Reports [Internet]. 2022 Mar 1 [cited 2022 Apr 22];5(2):e551. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/hsr2.551

20. Salker MS, Khorram O, Jericevic BM, Al-Hendy A, Navarro A, Bariani MV, *et al*. Understanding the Impact of Uterine Fibroids on Human Endometrium Function. 2021; Available from: www.frontiersin.org

21. Saad Helal A, Abdel-Hady E-S, Refaie E, Shamy E, Abd R, Fattah E, *et al*. Preliminary uterine artery ligation versus pericervical mechanical tourniquet in reducing hemorrhage during abdominal myomectomy; Preliminary uterine artery ligation versus pericervical mechanical tourniquet in reducing hemorrhage during abdominal myomectomy. 2009;

22. Chen WH, Huang KH, Kung FT. Effects of uterine artery occlusion during myomectomy on ovarian reserve: Serial follow-up of sex hormone levels, ultrasound parameters and Doppler characteristics. J Obstet Gynaecol Res [Internet]. 2020 May 1 [cited 2022 Sep 2];46(5):752. Available from: /pmc/articles/PMC7317349/

23. Laughlin SK, Schroeder JC, Baird DD. New directions in the epidemiology of uterine fibroids. Semin Reprod Med [Internet]. 2010 [cited 2022 Jul 12];28(3):204–17. Available from: http://www.thieme-connect.com/products/ejournals/html/10.1055/s-0030-1251477

24. Bray MJ, Torstenson ES, Jones SH, Edwards TL, Velez Edwards DR. Evaluating risk factors for differences in fibroid size and number using a large electronic health record population. Maturitas [Internet]. 2018;114(April):9–13. Available from: https://doi.org/10.1016/j.maturitas.2018.05.003

25. Juhasz-Böss I, Jungmann • Peter, Radosa J, Von Heesen A, Ströder R, Juhasz-Böss S, *et al*. Two novel classification systems for uterine fibroids and subsequent uterine reconstruction after myomectomy. Arch Gynecol Obs. 2017;(295):675–680.

26. ElSokary HA, Abdullah LS, Ujaimi A, Sahly NN, Mansouri N, Banaganapalli B, *et al*. Assessing the role of serum prolactin levels and coding region somatic mutations of the prolactin gene in Saudi uterine leiomyoma patients. Arch Med Sci. 2020;1–10.

27. 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 Diagnostic Res. 2016;10(5):QC10–3.

28. Ikechebelu JI, Ezeama CO, Obiechina NJA. The use of torniquet to reduce blood loss at myomectomy. Niger J Clin Pract. 2010;13(2):154–8.

29. Agameya AM, Saleh H, Moiety F. Minimizing bleeding in laparotomic myomectomy: A comparative study. Indian J Obstet Gynecol Res. 2018;5(1):49.

30. Zullo F, Palomba S, Corea D, Pellicano M, Russo T, Falbo A, *et al*. Bupivacaine plus Epinephrine for laparoscopic myomectomy: A randomized placebo-controlled trial. Obstet Gynecol [Internet]. 2004 Aug [cited 2022 Jul 15];104(2):243–9. Available from: https://journals.lww.com/greenjournal/Fulltext/2004/08000/Bupivacaine_Plus_Epinephrine_for_Laparoscopic.7.aspx

31. Darwish AM, Nasr AM, El-Nashar DA. Evaluation of postmyomectomy uterine scar. J Clin Ultrasound. 2005;33(4):181–6.