

## Original Investigations

### Can the application of a temporary uterine tourniquet during an abdominal myomectomy reduce bleeding?

Akbaba et al. Temporary uterine tourniquet in myomectomy

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#### Abstract

**Objective:** Uterine fibroids are common benign uterine tumours. The three most common surgical treatment approaches for uterine fibroids are laparoscopic, robotic and abdominal myomectomies. Bleeding is a risk with all three approaches. The present study compared post-operative and pregnancy outcomes in patients with bilateral uterine artery occlusion who underwent an abdominal myomectomy, with or without a temporary uterine tourniquet.

**Material and Methods:** This retrospective study included 84 patients with intra-mural fibroids ( $\geq 5$  cm) who underwent an abdominal myomectomy. The patients were divided into two groups according to the use ( $n = 36$ ) or non-use ( $n = 48$ ) of a temporary uterine tourniquet, and post-operative and pregnancy outcomes in the tourniquet use and non-use groups were then compared. The association of uterine fibroid removal number ( $\leq 3$  and  $> 3$ ) with laboratory parameters were also evaluated.

**Results:** There was a statistically significant difference between the groups with  $> 3$  myomas removed and with a uterine tourniquet applied and not applied in terms of haemoglobin (Hb) drop, haematocrit (Hct) drop, transfusion amounts, operation times and lengths of hospitalization in favour of the uterine tourniquet use group ( $p = 0.019$ ,  $p = 0.023$ ,  $p = 0.012$ ,  $p = 0.044$  and  $p = 0.036$ , respectively). Bilateral uterine arterial occlusion using a temporary uterine tourniquet had no negative effects on pregnancy outcomes.

**Conclusion:** A temporary uterine tourniquet may be an effective method for reducing the amount of perioperative bleeding in patients with multiple, large-sized myomas located close to vascular structures.

**Keywords:** Blood loss, leiomyoma, myomectomy, uterine artery occlusion.

#### Introduction

Uterine fibroids, also known as leiomyomas or myomas, are common benign uterine tumours. Leiomyomas are detected in 50–60% of women aged 50 years and younger, with the rate increasing after the age of 50 years to 70% [1]. According to previous research, 25% of all

leiomyomas will require treatment (1). The uterus has a rich supply of blood vessels, with blood supplied from various sources. The uterine arteries, which are branches of the anterior division of the internal iliac artery, are the main source of the blood supplied to the uterus and the only source of the vascular supply to uterine fibroids (2, 3). As most of the blood that enters the uterus does so through uterine arteries, transient uterine ischemia may occur following occlusion of the arteries using a catheter or tourniquet. Shortly after occlusion of the arteries, blood within the myometrium clots, the myometrium becomes hypoxic, and the metabolic pathway shifts from oxidative metabolism to anaerobic glycolysis. Some hours after occlusion, lysis of blood clots within the myometrium occurs, followed by reperfusion of the uterus through collateral arteries (4).

The three most common surgical treatment methods for uterine fibroid removal are laparoscopic, robotic and abdominal myomectomies (5). Due to the highly vascular nature of uterine fibroids, bleeding is a risk with all three surgical methods (6). Previous research reported mean blood loss in a myomectomy of 150–1,050 ml and a blood transfusion rate of 20% (7). Uterine bleeding during surgery and intra-operative transfusions may give rise to long-term complications (e.g. red blood cell antibodies), in addition to increased perioperative morbidity and mortality, and may affect the outcomes of future pregnancies (8, 9).

This study aimed to evaluate the effectiveness of a temporary tourniquet in reducing blood loss in abdominal myomectomy cases and to determine whether bilateral uterine artery occlusion had adverse consequences for future pregnancies.

### **Material and Methods**

This retrospective study was approved by institutional review board ethics committee (November 11th, 2020; No: 13/II). All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Prior to undergoing surgery, written informed consent was obtained from all the participants.

Eighty-four patients who underwent an abdominal myomectomy between January 2015 and January 2019 to remove intra-mural myomas at least 5 cm in size, as detected by pre-operative imaging were included in the study. In all cases, the cytopathological diagnosis was a leiomyoma. The indications for a myomectomy were symptomatic leiomyomas causing pelvic pain and abnormal uterine bleeding, together with symptomatic anaemia and feelings of pressure in the urinary bladder, bowel or pelvic vessels. Patients who underwent a laparoscopic myomectomy, patients aged < 18 years, pregnant patients and patients with a cytopathological diagnosis of a malignant myoma or an adenomyoma were not included in the study. The same surgeon performed all the surgeries.

Pre-operative demographic characteristics, pre- and post-operative laboratory values and were obtained from the electronic medical records and patients' files. The demographic characteristics recorded included age, gravida and body mass index (BMI). Data on abdominal surgery history, indications for surgery, duration of hospital stay and length of the surgical procedure were also recorded. In addition, pre-operative haemoglobin (Hb)/haematocrit (Hct) values, post-operative 24-hour Hb/Hct values, Hb and Hct drop values and blood transfusion information were recorded. All the patients were contacted by phone and asked about post-operative symptoms, pregnancies and pregnancy-related outcomes.

The patients were divided into two groups according to the use ( $n = 36$ ) or non-use ( $n = 48$ ) of a temporary uterine tourniquet, and the patients' intra-operative and post-operative laboratory and clinical results were compared. In addition, the association between the number of uterine fibroids removed ( $\leq 3$  and  $> 3$ ) and laboratory parameters in the tourniquet use and non-use groups was analysed.

### **Surgical technique**

A laparotomy was performed with a Pfannenstiel or median incision. Temporary bilateral uterine artery occlusion was performed in patients with multiple myomas, submucous myomas and myomas those are close proximity to vascular areas. A Penrose drain was used for temporary uterine artery occlusion. A window with a diameter of 1–2 cm was opened between the bilateral ligamentum latum leaves, and the drain, approximately 20 cm long, was passed through the window. A pericervical ring was formed at the junction of the cervix of the uterus with the Penrose drain. The Penrose drain was tied on the anterior surface of the uterus using at least three surgical knots at the level of the internal cervical os. The myomas were not injected with vasopressin before the myomectomy. At the point where the myoma projected from uterus, an incision was made using a monopolar cautery or scalpel, and the myoma was enucleated. After myoma enucleation, the myometrium was closed using the baseball technique with one or two layers of no: 0 Vicryl® (polyglactin 910, Ethicon, USA) suture. After repair of the myometrium, the Penrose tourniquet was removed using scissors.

### **Statistical analysis**

The data were analysed using the Statistical Package for Social Science (SPSS), version 20.0 for Windows (IBM Corp., Armonk, NY) program. Summary statistics are given as mean  $\pm$  standard deviation, median and (min-max) and percentage. The Independent samples *T*-test was applied for continuous variables. The Mann–Whitney *U*-test was used for inter-group comparisons of parameters without a normal distribution. A chi-square test was used for comparison of categorical data. In all the analyses, a value of  $p < 0.05$  was considered statistically significant.

### **Results**

Eighty-four patients who underwent a laparotomic myomectomy were retrospectively included in this study. The demographic characteristics of the patients in the tourniquet use ( $n = 36$ ) and non-use groups ( $n = 48$ ) were similar ( $p > 0.05$ ) (Table 1). There was no statistically significant difference between the two groups in terms of haemorrhages, transfusion needs, operative times and lengths of hospitalization ( $p > 0.05$ ) (Table 2). There was also no statistically significant difference in the pre- and post-operative Hb, Htc, Hb drop and Htc drop values of the tourniquet and non-tourniquet use groups ( $p > 0.05$ ).

When the patients were evaluated according to the number of uterine myomas removed during the abdominal myomectomy, there was no statistically significant difference in blood loss amounts, transfusion needs and lengths of hospitalization in those with  $\leq 3$  myomas removed irrespective of the use or non-use of a tourniquet ( $p > 0.05$ ) (Table 3). Post-operative Hb and Hct values of patients in the non-tourniquet use group with  $> 3$  intra-mural myomas removed were significantly lower ( $7.12 \pm 1.13$  and  $9.14 \pm 1.21$ , respectively,  $p = 0.030$ ) than those of patients with  $> 3$  intra-mural myomas removed in the tourniquet use group ( $22.04 \pm 3.54$  and  $29.01 \pm 2.88$ , respectively,  $p = 0.041$ ). In the patients with  $> 3$  uterine fibroids removed, post-operative Hb and Htc values were significantly higher and Hb and Htc drop values were significantly lower in the tourniquet use group as compared to those in the non-use group ( $p = 0.030$ ,  $p = 0.019$ ,  $p = 0.041$  and  $p = 0.023$ , respectively). The transfusion amounts, operative times and lengths of hospitalization were significantly lower in the tourniquet use group as compared to those in the non-use group ( $p = 0.012$ ,  $p = 0.044$  and  $p = 0.036$ , respectively) (Table 3).

Twelve (33%) patients in the tourniquet use group and 17 (35.4%) patients in the tourniquet non-use group reported pregnancy during the post-operative period. The total number of pregnancies in the two groups was similar ( $p = 0.105$ ) (Table 4). Uterine tourniquet use had no adverse effects on pregnancy outcomes in terms of total number of pregnancies, miscarriages, assisted reproductive pregnancies, live births, birth weights, gestational week at birth, stillbirth, uterine rupture and placenta previa.

## Discussion

The most common symptoms of myomas, which are sex steroid hormone-dependent benign uterine tumours, are menorrhagia and anaemia. A myomectomy is the most common surgical treatment method for women with symptomatic leiomyomas who wish to retain their uterus and fertility (10). Perioperative bleeding is the most common complication in a myomectomy (6). Previous research reported that the surgery duration and uterine leiomyoma number were risk factors for increased blood loss, with a longer surgery duration and removal of multiple uterine leiomyomas associated with increased blood loss(11). This research also reported that increased myomectomy-related blood loss contributed to delayed post-operative recovery by increasing the need for blood transfusions and the risk of fevers, infections and abdominal adhesions (12).

The present study included 84 patients with intra-mural myomas of  $\geq 5$  cm and a cytopathological diagnosis of a leiomyoma who underwent an abdominal myomectomy. In our study, a temporary uterine tourniquet was applied in 36 (43%) of the 84 patients. We detected no statistically significant difference in blood loss amounts, transfusion needs or operative times in those with  $\leq 3$  myomas removed in the uterine tourniquet use and non-use groups. Previous studies reported that the size of the uterus, duration of the operation and total number and weight of myomas removed may affect the amount of blood loss during a myomectomy(13). In this study, in patients in the non- tourniquet use group with  $>3$  uterine fibroids removed, post-operative Hb and Htc values were significantly lower and Hb and Htc drop values were significantly higher, transfusion amounts were significantly higher, and lengths of hospitalization were significantly longer as compared to these parameters in the tourniquet use group in patients with  $\leq 3$  uterine fibroids removed.

Intra-myometrial vasopressin and its analogues, intravenous oxytocin, intravenous or vaginal misoprostol, intra-myometrial bupivacaine and epinephrine and tranexamic acid are commonly used in myomectomies to reduce intra-operative bleeding, although there is no strong recommendation that they achieve this goal. However, there is evidence to suggest that a uterine tourniquet reduces bleeding during a myomectomy (14-16). Alptekin et al. reported reduced blood loss in no tourniquet use versus that in patients in whom a tourniquet (Foley catheter) was applied before a myomectomy, with mean blood loss of  $673.8 \pm 172.3$  ml and  $286.4 \pm 137.5$  ml, respectively(17). Taylor et al. first applied triple tourniquets at the level of the uterine cervix to ovary propriums (18), and they then applied a uterine tourniquet only at the level of the uterine cervix in subsequent studies. Similar to our results, they reported that the uterine tourniquets reduced the amount of bleeding, need for erythrocyte transfusions and operative times, particularly in myomectomies of patients with multiple myomas. Using a Foley catheter as a uterine tourniquet in myomectomy cases, Ikechebelu et al. detected a significant decrease in mean blood loss in the tourniquet use group versus that in a non-tourniquet use group (19). In their study, the mean blood loss in the tourniquet use group was  $515.7 \pm 292.8$  ml versus  $756.4 \pm 285.7$  ml in the tourniquet non-use group, and the erythrocyte transfusion amounts in the two groups were  $0.24 \pm 0.51$  and  $1.0 \pm 1.14$  units, respectively. Kwon et al. investigated blood loss in 168 patients who underwent laparoscopic myomectomies or adenomyomectomies, with or without transient occlusion of the uterine arteries using temporary clips (20). The mean estimated blood loss was significantly lower in the patients in the temporary uterine artery occlusion group than in the non-occlusion group. In our study, we used a Penrose drain as a uterine tourniquet elaborating on the effectiveness of the tourniquet used in reducing blood loss amounts/transfusion amounts. The data in our study were consistent with those of Kwon et al.(20).

Although uterine tourniquet application seems to prolong the duration of the operation, previous studies have reported that the use of a tourniquet reduces the amount of bleeding and shortens the duration of the operation (21). In a myomectomy study by Mehdizadehkashia et

al., they used a Penrose drain to achieve uterine artery occlusion, protecting the uterine tubes and ovarian arteries (21). They concluded that the tourniquet did not prolong the operation time or reduce the amount of bleeding. Page: 5

In our study, the operation times in patients with > 3 myomas removed were shorter in the uterine tourniquet use group than in the non-tourniquet use group.

A previous study investigated the effects of a uterine Penrose drain tourniquet on the ovarian reserve, assessing follicle stimulating hormone and anti-mullerian hormone values. The authors concluded that the tourniquet had no negative effects on ovarian reserve (22). Another study that focused on the effects of triple and single uterine tourniquets during myomectomies also concluded that tourniquet use had no significant effect on the ovarian reserve, as determined by anti-mullerian hormone levels (23). In a meta-analysis by Sanders et al. of patients who underwent a myomectomy with ( $n = 470$ ) or without ( $n = 219$ ) uterine artery occlusion, the authors detected no between-group differences in the courses of subsequent pregnancies or live birth rates (24). In our study, 12 (33%) patients in the tourniquet use group and 17 (35.4%) patients in the tourniquet non-use group became pregnant during the post-operative period. We detected no difference between the pregnancy outcomes of the patients in the uterine tourniquet use and non-use groups.

The present study has a number of limitations. The first limitation is clearly the retrospective design of the study. Another limitation is that we used Hb and Hct values to determine the amount of intra-operative and post-operative bleeding. A strength of our study is that we investigated pregnancy outcomes in the uterine tourniquet use and non-use groups.

### Conclusion

A laparotomic myomectomy is the most common treatment option for women with symptomatic leiomyomas who wish to retain fertility. Bleeding is the most common complication during a myomectomy. The application of a temporary uterine Penrose drain tourniquet seemed to be effective in reducing the amount of perioperative bleeding, particularly in patients with multiple, large-sized myomas located close to vascular structures. Moreover, the uterine tourniquet did not seem to have adverse effects on pregnancy outcomes. Randomized prospective studies with larger numbers of patients are needed to determine the most effective myomectomy method and the effects of various myomectomy methods on fertility.

**Conflict of Interest:** No conflict of interest is declared by the authors.

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**Table 1.** The demographic characteristics of the patients.

Variables	Without UT (n=36), <sup>a</sup> Mean $\pm$ SD, <sup>b</sup> Median (min-max)	With UT (n=48), <sup>a</sup> Mean $\pm$ SD, <sup>b</sup> Median (min-max)	p
Age (year)	41 [28–51]	40 [24–48]	<sup>b</sup> 0.211
BMI (kg/m <sup>2</sup> )	29.86 $\pm$ 4.21	27.42 $\pm$ 3.43	<sup>a</sup> 0.082
Gravidity (n)	2 [1–5]	2 [1–5]	<sup>b</sup> 0.253
Myoma size (cm)	7 [5–11]	6 [5–14]	<sup>b</sup> 0.482
Number of myomas (n)	3.68 $\pm$ 1.39	3.12 $\pm$ 1.33	<sup>b</sup> 0.121

UT: uterine tourniquet; SD: standard deviation, BMI: body mass index. <sup>a</sup>Independent samples T-test; <sup>b</sup>Mann–Whitney U-test

**Table 2.** Post-operative outcomes of patients with and without uterine tourniquet application

Variables	Without UT (n = 36), <sup>a</sup> Mean $\pm$ SD, <sup>b</sup> Median [min-max]	With UT (n = 48), <sup>a</sup> Mean $\pm$ SD, <sup>b</sup> Median [min-max]	p
Pre-op Hb (g/dL)	9.92 $\pm$ 1.14	10.59 $\pm$ 1.15	<sup>a</sup> 0.115
Post-op Hb (g/dL)	9.08 $\pm$ 1.10	8.72 $\pm$ 1.38	<sup>a</sup> 0.128
Pre-op Htc	30.09 $\pm$ 3.15	31.92 $\pm$ 3.34	<sup>a</sup> 0.098
Post-op Htc	27.77 $\pm$ 3.59	26.11 $\pm$ 4.12	<sup>a</sup> 0.276
Transfusion (units)	0 [0–5]	0 [0–5]	<sup>b</sup> 0.071
Operative time (min)	70 [52–86]	68 [51–80]	<sup>b</sup> 0.276
LOH (day)	1 [1–3]	1 [1–3]	<sup>b</sup> 0.427

UT: uterine tourniquet, SD: standard deviation, Pre-op: pre-operative, Post-op: post-operative, Hb: haemoglobin, Htc: haematocrit, LOH: length of hospitalization. \*Significant at the 0.05 level. <sup>a</sup>Independent samples T-test; <sup>b</sup>Mann–Whitney U-test

**Table 3.** Association between the number of myomas removed and post-operative outcomes

	Intra-mural myoma number ( $\leq 3$ )			Intra-mural myoma number ( $> 3$ )		
	Without UT n = 32 (38%) <sup>a</sup> Mean $\pm$ SD <sup>b</sup> Median [min-max]	With UT n = 14 (16%) <sup>a</sup> Mean $\pm$ SD <sup>b</sup> Median [min-max]	p	Without UT n = 16 (19%) <sup>a</sup> Mean $\pm$ SD <sup>b</sup> Median [min-max]	With UT n = 22 (26%) <sup>a</sup> Mean $\pm$ SD <sup>b</sup> Median [min-max]	p
Pre-op Hb (g/dL)	10.77 $\pm$ 1.31	10.68 $\pm$ 1.22	<sup>a</sup> 0.345	9.94 $\pm$ 1.08	10.24 $\pm$ 1.33	<sup>a</sup> 0.101
Post-op Hb (g/dL)	9.91 $\pm$ 1.25	9.94 $\pm$ 1.38	<sup>a</sup> 0.068	7.12 $\pm$ 1.13	9.14 $\pm$ 1.21	<sup>a</sup> <b>0.030*</b>
Hb drop	0.86 $\pm$ 1.16	0.74 $\pm$ 1.18	<sup>a</sup> 0.073	2.82 $\pm$ 1.05	1.1 $\pm$ 1.17	<sup>a</sup> <b>0.019*</b>
Pre-op Htc	32.02 $\pm$ 2.94	31.74 $\pm$ 2.06	<sup>a</sup> 0.088	30.04 $\pm$ 1.85	31.11 $\pm$ 3.03	<sup>a</sup> 0.221
Post-op Htc	27.30 $\pm$ 3.94	27.01 $\pm$ 3.25	<sup>a</sup> 0.413	22.04 $\pm$ 3.54	26.01 $\pm$ 2.88	<sup>a</sup> <b>0.041*</b>
Htc drop	4.72 $\pm$ 2.85	4.73 $\pm$ 2.1	<sup>a</sup> 0.113	8.01 $\pm$ 3.25	5.1 $\pm$ 3.66	<sup>a</sup> <b>0.023*</b>
Transfusion (units)	0 [0–3]	0 [0–4]	<sup>b</sup> 0.098	1 [0–5]	0 [0–4]	<sup>b</sup> <b>0.012*</b>
Operative time (min)	65 [52–75]	64 [51–73]	<sup>b</sup> 0.179	79 [65–86]	71 [63–80]	<sup>b</sup> <b>0.044*</b>
LOH (day)	1 [1–5]	1 [1–5]	<sup>b</sup> 0.421	2 [1–5]	1 [1–5]	<sup>b</sup> <b>0.036*</b>

UT: uterine tourniquet, SD: standard deviation, Pre-op: pre-operative, Post-op: post-operative, Hb: haemoglobin, Htc: haematocrit, LOH: length of hospitalization. \*Significant at the 0.05 level. <sup>a</sup>Independent samples T- test; <sup>b</sup>Mann–Whitney U-test

**Table 4.** Pregnancy outcomes of patients with and without uterine tourniquet application

	Without UT (n = 48)	With UT (n = 36)	p
Total number of pregnancies (n) (%)	17 (35.4%)	12 (33%)	<sup>c</sup> 0.105
Spontaneous pregnancies (n) (%)	15 (88%)	9 (75%)	<sup>c</sup> 0.084
Post-op average spontaneous gestational age (n) [min-max]	33 [27–38]	31 [26–41]	<sup>b</sup> 0.432
Assisted reproductive pregnancies (n) (%)	2 (12%)	3 (25%)	<sup>c</sup> 0.267
Miscarriage (n) (%)	3 (17.6%)	3 (25%)	<sup>c</sup> 0.195
Live birth (n) (%)	14 (82.4%)	9 (75%)	<sup>c</sup> 0.351
Pre-term birth (n) (%)	4 (28.5%)	4 (44.4%)	
Term birth (n) (%)	10 (71.5%)	5 (55.6%)	
Gestational week at birth (week) (n) [min-max]	35 [29–37]	33 [30–38]	<sup>b</sup> 0.077
Birth weight (g) (mean $\pm$ SD)	2720.42 $\pm$ 190.20	2540.38 $\pm$ 210.24	<sup>a</sup> 0.092
Stillbirth (n)	0	0	
Uterine rupture (n)	0	0	
Placenta previa (n)	1	1	

UT: uterine tourniquet, SD: standard deviation, \* Significant at the 0.05 level. <sup>a</sup>Independent samples T-test; <sup>b</sup>Mann–Whitney U-test; <sup>c</sup>Chi-square test