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ORIGINAL ARTICLE

Temporary clipping of the uterine artery during laparoscopic myomectomy—a new technique and the results of first cases

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Abstract Bleeding is the most common complication in laparoscopic myomectomy. In this paper, we describe a new technique using Yasargil aneurysm clips to reduce blood loss during laparoscopic myomectomy by clipping the uterine arteries temporarily. Over a 7-month period, 13 patients with uterine fibroids larger than 5 cm underwent laparoscopic myomectomy with temporary clipping of both uterine arteries at their origin from the internal iliac artery. We assessed the clinical data of perioperative blood loss, operating time, hospital stay, complications, haemoglobin decrease and uterine artery Doppler flow prior to and after the procedure. No serious perioperative complications occurred. The mean number of removed fibroids was 7.5 (range 1–30), with an average total weight of 421 g (range 160–960 g). Mean Hb pre- vs. postoperatively was 12.5 g/cl vs. 10 g/cl. There was no significant change in the uterine artery flow prior to and after surgery. No transfusion was given to any of the patients. We conclude that temporary clipping of the uterine arteries prior to laparoscopic myomectomy is a safe procedure for controlling excessive blood loss without jeopardising the uterine blood supply.

Keywords Laparoscopy · Uterine myoma · Myomectomy · Blood loss · Aneurysm clip · Infertility · Yasargil · Fibroids

Introduction

Uterine leiomyoma are present in at least 25% to 35% of women over the age of 35 years [1]. Most of these women are asymptomatic, but in approximately 34% of patients, uterine fibroids are associated with a wide spectrum of disorders, such as abnormal bleeding, pelvic pain, dysmenorrhoea, dyspareunia and infertility [2].

For symptomatic women who desire to preserve fertility, myomectomy is the first choice of treatment. This can be performed by laparotomy, laparoscopy or hysteroscopy. During these procedures, bleeding is the most common complication. A recent study reported a blood loss of over 1,000 ml in 23% of patients [3]. Other studies reported blood transfusion rates between 18% and 24% [4–6]. The enucleation of fibroids and the reconstruction of the uterine wall may be difficult to perform while there is still bleeding. Blood transfusion or hypovolaemic shock may result. Uncontrolled bleeding sometimes renders hysterectomy inevitable [7]. Thus, the appropriate control of bleeding is a key target in myomectomy procedures.

In order to achieve better haemostasis, various approaches have been reported, such as the administration of GnRH analogues [1], embolisation [8], the administration of vasoconstrictive drugs [7], permanent bilateral uterine ligation [9] or tourniquets [10]. Whether these methods are advantageous in patients with infertility remains to be shown.

We investigate a new technique to reduce blood loss during laparoscopic myomectomy using Yasargil artery clips for the temporary and atraumatic closure of the uterine arteries.

Materials and methods

Pre- and postoperative data of women who underwent laparoscopic myomectomy at the Department of Gynaecology at Charité, Berlin University of Medicine, Germany, over a 7-month period (August 2005 to February 2006) were registered prospectively. Only patients with symp-

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tomatic uterine fibroids were included. All patients were informed preoperatively and gave written consent to this new operative method. The Charité's institutional review board approved of the trial.

A uniform patient chart was used during this period to record data on medical history, number and size of the different myomas, operating time, pre- and postoperative Hb (haemoglobin) level, pre- and postoperative uterine artery Doppler values RI and PI (resistence and pulsatility indices) and pre- and postoperative complications. All data were collected systematically in an electronic file (Microsoft Excel).

Technique

The patient is placed lying in a 20° head-down Trendelenburg position. The procedure is started with placing a 10-mm umbilical or left subcostal laparoscopic trocar. Two 5-mm instrument trocars are placed 2 cm cranially and medially of the anterior superior iliac spine. A fourth, 12-mm, trocar is inserted 5 cm suprapubically. This trocar is also used for the morcellator during the final part of the procedure. Apart from the Yasargil clips, standard instruments were used (Fig. 1).

The technique of identification of the uterine vessels at their origin has been described before in the laparoscopically assisted vaginal hysterectomy (LAVH) procedure by Koehler et al. [11]. After the identification of the ureter and the external and internal iliac arteries, the upper part of the pararectal space is opened by blunt dissection. Under permanent medialisation of the ureter, we follow the internal iliac artery until its branching off into the uterine artery and the lateral umbilical ligament is visible (Fig. 2).

The surgeon then isolates the uterine artery over a distance of 2–3 cm from its origin, thus, achieving sufficient space for the placement of the clip.

Fig. 1 Kelly Bipolar grasping forceps, Metzenbaum scissors (curved), Schneider lymph node grasping forceps (atraumatic), Yasargil clip, grasping forceps (atraumatic, double spoon, with multiple teeth) and tenaculum forceps (10-mm diameter). Instruments: Karl Storz, Germany

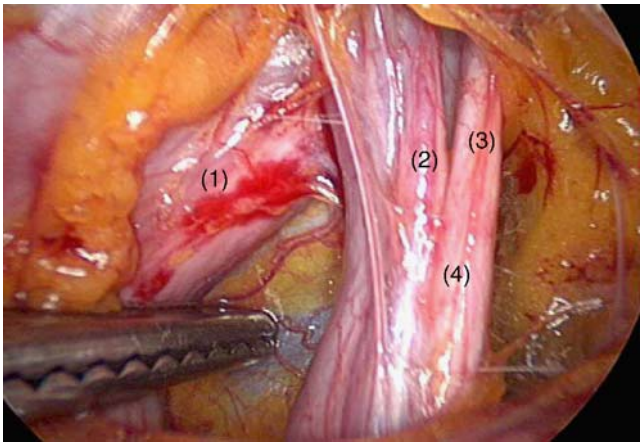

Fig. 2 (1) Ureter medialised with a Schneider lymph node grasping forceps to allow more vision and space to place the Yasargil clip. (2) Right uterine artery. (3) Lateral umbilical ligament. (4) Internal iliac artery

The Yasargil clip is brought into the abdomen via the umbilical trocar (Fig. 3). The clips are fitted with a 10-cm Vicryl thread for two reasons: first, when removing the clip, pulling the thread is sufficient to let the clip slip off the artery, thus, there is no need to open the pararectal fossa again; secondly, in case of accidental loss of the tiny clip, the long thread is easily discovered in the abdomen.

The clip is now placed over the uterine artery with an atraumatic, double spoon grasping forceps. Gentle lifting of the clip will show whether it is tightly closed over the whole arterial diameter (Fig. 4).

The same procedure is performed contralaterally. After the completion of myomectomy reconstruction of the uterotomy by intracorporal sutures, the fibroids are morcellated. The clips are removed using the Vicryl threads attached. It is essential to then re-check all sutures and uterotomies to safeguard appropriate haemostasis and to

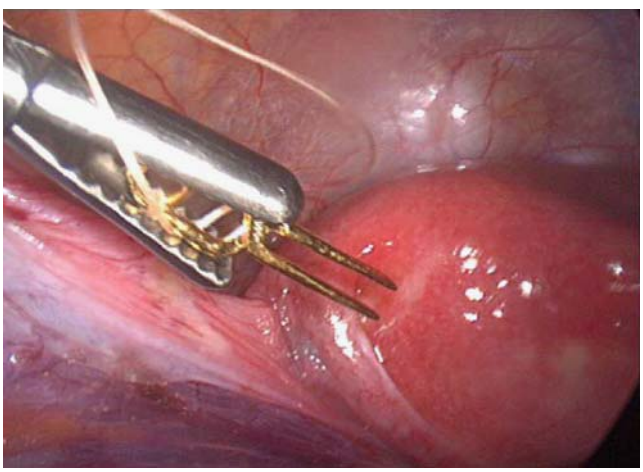

Fig. 3 A Yasargil clip opened with grasping forceps (atraumatic, double spoon, with multiple teeth). Compressing the spring part will open the straight smooth blades. The Vicryl thread attached to the clip facilitates the location and removal of the clip

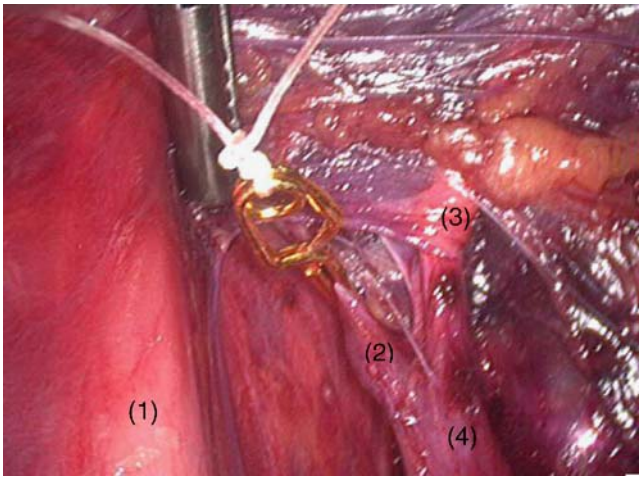

Fig. 4 (1) Right ureter medialised. (2) A Yasargil clip placed over the right uterine artery. (3) Lateral umbilical ligament. (4) Internal iliac artery

discover potential bleeding after the reopening of the uterine arterial circulation.

Results

Thirteen patients with large or multiple uterine fibroids were operated between August 2005 and February 2006 at the Department of Gynaecology, Charité, Berlin University of Medicine, Germany. The operative details of the patients are summarised in Table 1.

All laparoscopic myomectomies with Yasargil clips were completed successfully. The mean number of myomas removed were 7.5 (range 1–30), with a mean size of 67 mm in diameter and a total mean weight of 421 g. The mean operating time was 273 min. Given the mean preoperative Hb of 12.5 g/cl and postoperative Hb of 10 g/cl, the mean drop was 2.5 g/cl. There was no blood transfusion necessary. No intraoperative complication occurred and no case had to be converted to open surgery because of intraoperative difficulties.

Table 1 Summary of the operative details of the patients

Operative results	
Operation time (min)	273 (120–390)
Number of fibroids	7.5 (1–30)
Size of largest fibroid (mm in diameter)	67 (25–130)
Total weight of fibroids (g)	421 (150–960)
Preoperative Hb (g/cl)	12.5 (9.7–14.7)
Postoperative Hb (g/cl)	10 (6.7–11.9)
Preoperative RI/PI uterine artery Doppler	0.69/1.30
Postoperative RI/PI uterine artery Doppler	0.74/1.39
Postoperative hospital stay (days)	5,25 (3–7)

The postoperative course was uneventful in all but one patient. This patient returned 15 days after the myomectomy of a single fibroid measuring 115 mm in diameter, weighing 960 g and presenting with a haematoma within the enucleation site. She was preventively treated with antibiotics and discharged 5 days later without further complaints.

Histological evaluation confirmed benign fibroids in all patients.

There were no significant changes in uterine artery Doppler RI or PI compared with preoperative values at the postoperative follow-up time of 2 to 3 days. Most of the patients were discharged 3 days after the operation.

Discussion

Yasargil aneurysm clips were introduced into neurosurgical practice more than 25 years ago. The clip is named after Michael G. Yasargil, Professor in Neurosurgery. The clips were designed to close blood vessels in difficult-to-reach intracranial locations. Made of titanium due to its better weight-to-strength ratio than its cobalt-chromium competitors, they may stay in situ without losing strength, do not corrode and show no artefacts on magnetic resonance imaging (MRI) or computed tomography (CT) scans [12].

Laparoscopic myomectomy provides an excellent alternative to abdominal myomectomy for women desiring uterine preservation and childbirth. Published reports have documented the advantages of laparoscopy over open surgery in non-blinded settings. The benefits of laparoscopic surgery include reduced hospital stay, a better cosmetic effect and decreased postoperative pain [13, 14]. However, the laparoscopic approach seems to be limited by the number and size of the fibroids [15, 16]. The major problems in laparoscopic myomectomy are operating time, bleeding control and overall blood loss.

In open myomectomy, temporary haemostatic occlusion of the uterine blood supply was first described in 1932 using metal clamps [17] following the even earlier ligation of the uterine arteries [18]. This technique of total vascular occlusion of the uterine blood supply is still recommended by some authors [19].

Various biochemical techniques of temporary haemostasis have also been described [3, 5]. Intramyometrial vasopressin has been compared with triple tourniquet and there was no reported difference [5]. It is also not approved for this indication in Germany. The preoperative administration of GnRH analogues has been shown to effectively reduce blood loss at open myomectomy [1]. However, they have been associated with symptoms of oestrogen deficiency as side effects and appear to be associated with an

increase in fibroid recurrence at 6 months [1]. Newly described is the uterotonic E-prostaglandin misoprostol as a preoperative medical agent. Further studies are needed to evaluate its usefulness [20].

Incorporating the existing data, there appear to be no side-effect-free or approved agents for the preoperative treatment of uterine fibroids.

Alternatives to the surgical management of uterine fibroids are uterine artery embolisation (UAE) and MR-guided focussed ultrasound (MRgFUS) [21, 22]. Recently, UAE has been associated with a high failure and complication rate [23]. Currently, both techniques are only recommended when preservation of the uterus is not needed for future pregnancy.

For the laparoscopic approach and for women who desire to preserve fertility, we developed the technique of temporary clipping of the uterine arteries using Yasargil clips. This procedure appears to improve the control of blood loss and keeps the surgical site "blood-free."

The mean drop in Hb was 2.5 g/cl and there was no blood transfusion required in any patient. Given the large size and average number of myomas removed, this appears to be highly satisfying. Fletcher et al. [3] report that 23% of their patients lost over 1,000 ml of blood and others report similar transfusion rates of between 18% and 24% [4–6]. Taylor et al. [10], using triple tourniquets at open myomectomy in a randomised controlled trial, reported a mean blood loss of 489 ml in the tourniquet group and 2,359 ml in the control group with blood transfusion rates of 0.7% and 79% respectively. The overall fall in Hb was 2.96 g/cl in the control group and 2.79 g/cl in the tourniquet group.

Our mean operating time was 273 min. This appears to be long in comparison with the published data reporting operating times in the region of 90–110 min [13, 24–27]. Our technique requires an extra 10 to 20 min of operating time for the clipping procedure. However, we did not evaluate time needed for the clipping, enucleation and morcellation procedures separately. We are looking into this in a randomised controlled trial which has started in January 2007. Another explanation for the extended operating time could be the average number (7.5) and large size (67 mm/421 g) of the fibroids we removed solely laparoscopically. The larger the fibroids, then the more time consuming is the uterine wound repair and morcellation [28]. Previous reports of laparoscopic myomectomies do not include data on the total weight of fibroids.

Additionally, there appears to be a potential risk of organ damage with the opening of the pararectal fossa, although we did not observe these in this study. The learning curve might be longer for the inexperienced surgeon. However, this might be offset by the time saved due to less coagulation and suction/irrigation.

Theoretically, there is a risk of uterine artery thrombosis due to the temporary stasis of blood flow. There are no data available on uterine artery flow pattern changes in laparoscopic myomectomy using uterine depletion techniques. In open myomectomy, Taylor et al. [10] showed no increase in the RIs of uterine artery flow with postoperative follow-up of up to 6 months. In accordance with their data, our pre- and postoperative uterine artery Doppler flow measures were unaltered and we have not encountered any thromboembolic complications so far.

Earlier studies suggest that laparoscopic myomectomy should be reserved for patients with less than four myomas and a maximum diameter of 7 cm [29] to avoid complications and the need to convert to laparotomy [30]. In our study, the largest fibroid was 13 cm in diameter, with no need for conversion to laparotomy. With the use of Yasargil clips, blood loss control appears to be improved and larger myomas can be treated by minimally invasive surgery.

In summary, our results demonstrate the potential effectiveness and convenience of Yasargil clipping of the uterine arteries at laparoscopic myomectomy to control intraoperative blood loss. In a two-armed, single-blinded randomised controlled trial that commenced in January 2007, we are evaluating this new technique versus conventional laparoscopic myomectomy. This will include additional information regarding detailed operating times and the use of newly developed clip application forceps.

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