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Review

Laparoscopic aortobifemoral bypass: An underappreciated treatment option for aortoiliac occlusive disease

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ABSTRACT

Laparoscopic aortobifemoral bypass surgery is a minimally invasive alternative to open surgery and endovascular treatment modalities. It was first described in the middle of 1990s. Since then, only small number of papers were published evaluating the outcomes of this procedure. In general, laparoscopic aortobifemoral bypass is a feasible and safe minimally invasive alternative to open surgical approach, when performed in experienced centers for patients with extensive aortoiliac occlusive disease. In this review, we discuss the current evidences behind this argument.

Keywords: Laparoscopy; aortoiliac occlusive disease; aortobifemoral bypass.

For many decades, benefits of laparoscopic surgery have been demonstrated, particularly in gastrointestinal, gynecologic, and urologic surgeries. Lower postoperative analgesia, early oral feeding, shorter hospital stays and better patient comfort are the main advantages of laparoscopic procedures.[1] Although it has started to lose its popularity today, according to the Trans-Atlantic Inter-Society Consensus Document on Management of Peripheral Arterial Disease (TASC II) recommendations, aortobifemoral bypass is accepted as the most optimal treatment option for patients with TASC II C and D aortoiliac occlusive disease. Nevertheless, the open technique is associated with higher complication, morbidity, and mortality rates with longer length of hospital and intensive care unit stay.[2]

Major developments in laparoscopic surgery in the 1990s dramatically changed the practice of vascular surgery. Totally laparoscopic aortic surgery for occlusive disease started with Dion who performed the first laparoscopically assisted aortobifemoral bypass in 1993 and the first totally laparoscopic procedure in 1995.[3,4] Since then, the technique has substantially evolved. The technique as described by Coggia et al.,[5] is the most preferred at the moment. Several publications have proven feasibility with acceptable short-term results of laparoscopic aortobifemoral bypass surgery.[6-9] However, endovascular surgery has become the first choice of many vascular surgeons all around the world for all aortoiliac lesions, and the interest in laparoscopic aortobifemoral has reduced and publications have come to a halt. Therefore, the widespread use of this technique has remained relatively low and the long-term patency rates are still unclear.

We believe that, in patients for whom endovascular treatment is contraindicated or failed, laparoscopic repair can be an alternative to conventional open aortic surgery as a less invasive approach with more favorable outcomes. In this review, we discuss laparoscopic aortobifemoral surgery and current evidences behind this argument.

Surgical techniques

In their pioneering work, Dion et al.[4] used a technique called as the Apron technique. In

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this technique, following dissection of the left retroperitoneal space by incising the peritoneum to the left of rectus muscle, a peritoneal 'apron' is created to expose the aorta.[4] It is a transperitoneal approach, but this approach is not always possible and can be difficult to apply.

Later, a simple and reproducible transperitoneal technique was demonstrated by Coggia et al.[5] also known as the Coggia's technique and started to widely used in this field by many surgeons. Using the Coggia's technique, the patient is placed in the right lateral and rotated decubitus position with the abdomen rotated at 45°. The abdominal slope obtained with the maximal right rotation of the operating table reaches 65°. The video monitor is placed on the left side of the patient. The surgeon faces the patient's abdomen. The endoscope is positioned through a trocar introduced on the anterior axillary line 3-cm below the costal margin (Figure 1). A left retrocolic dissection is conducted in line of the Told's fascia, down to reach the left renal vein. Due to the right lateral decubitus, the small bowel and left mesocolon drop fall to the right part of the abdomen. The aorta and common iliac arteries are, then, exposed (Figure 2). After achieving the dissection of intraabdominal vascular structures, the operating table is rotated on the left, for conventional preparation of femoral arteries. The operating table is, then, rotated back to its maximal position. The vascular graft is taken into the abdominal cavity through one of the trocars. The right tunnel is created, and the right limb of the graft is brought out. The proximal and distal clamps are positioned through trocars. Before aortic clamping, sutures are prepared for the anastomosis. Two polypropylene sutures, 20 cm of length, are knotted on a pledget for two hemi-circumferential continuous sutures. The proximal anastomosis is performed with the running style. The sutures are previously knotted on a prosthetic pledget. The left limb of the graft is, then, brought down to the groin. After the limbs are positioned, the operating table is rotated on the left and distal anastomoses are performed.

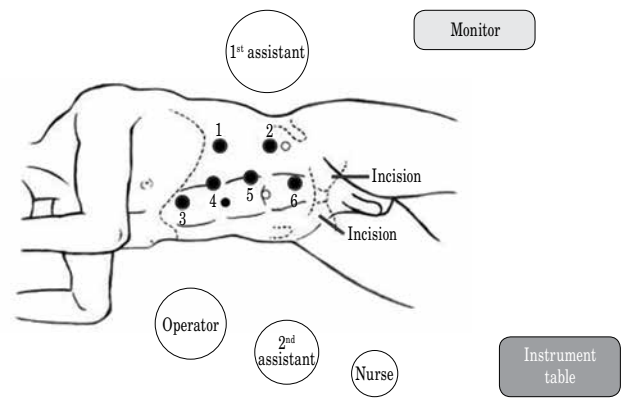

Figure 1. "Coggia's Technique" Typical installation of the patient on the operating table with the bust and the pelvis rotated. Basic operating room setup after the maximal right rotation of the operating table and sites of trocar insertion. 1, 10 mm trocar for laparoscope. 4 and 5, 10 mm trocars for operator instruments. 2, 5 mm trocar for suction/irrigation. 3 and 6, 10 mm trocars for proximal and distal coelioscopic aortic clamps.

Short and mid-term outcomes

In 1998, Barbera et al.[10] presented their experience with operative results of 24 totally laparoscopic vascular procedures for aortoiliac occlusive disease. The mean operation time was 279±69 min. The mean amount of blood loss was 563±516 mL and the mean length of postoperative stay was 10.1 days for aortobifemoral bypass. From pioneers of laparoscopic aortobifemoral surgery, Coggia et al.[7] shared their experiences with transperitoneal technique in the first 93 patients in 2004. The median operation time was shorter than the previous study with 240 (range, 150 to 450) min. The median aortic clamp time measured to unclamping of the first prosthetic limb was 67.5 (range, 30 to 135) min. The median duration of aorta-prosthesis anastomosis was 30 (range, 12 to 90) min. The mortality rate was 4% (4/93) on postoperative Day 30. One of these patients died of colonic ischemia and the other causes of mortality were unrelated with the procedure. The median length of hospital stay was seven (range, 2 to 57) days. One patient had kinking of a prosthetic limb at the groin and one patient developed graft infection during follow-up. In the same year, Dion et al.[9] reported their early and mid-term results and it was the first article in the literature reporting short

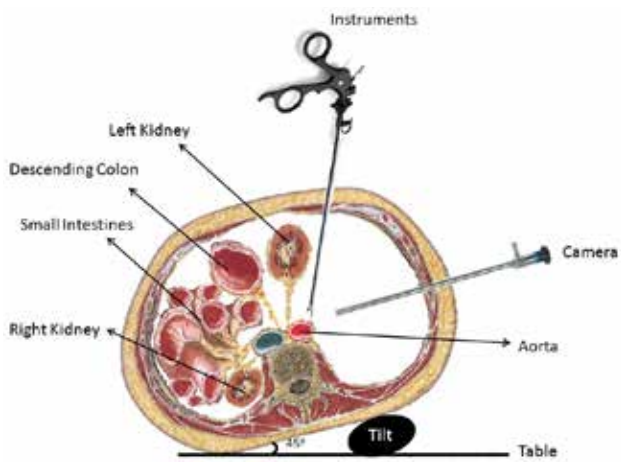

Figure 2. Transverse section showing the abdomen and the orientation of the surgical instruments.

and medium-term results using a totally laparoscopic technique for aortoiliac disease. Among 41 patients, three were an iliofemoral bypass and one case was an aortoaortic bypass. One conversion to standard open surgery and one death unrelated to the technique were reported. There were few major perioperative complications and all were reported in the early phase of the study (one intraoperative embolization to the lower branches and one acute aortic pseudoaneurysm). Mid-term results were favorable, demonstrating two limb graft thromboses. The most spectacular result was that the conversion rate was lower than that reported for acute cholecystitis before. One year later, in a prospective study, Lin et al.[11] reported outcomes of 68 consecutive patients who underwent total laparoscopic aortofemoral bypass. The mean operation time was 199 min, with a mean aortic cross-clamp time of 85.8 min. There were five major complications (7.3%). The mean length of postoperative hospital stay was 6.3 days in this study. The authors eventually concluded that laparoscopic aortobifemoral bypass could be done as a routine procedure to the majority of patients with aortoiliac occlusive disease. Early and mid-term results of 150 patients operated by Coggia's group[8] were published in 2008 and they reported three-year primary and secondary actuarial patency rates of 93% and 95.6%, respectively during a mean follow-up of 25.2±17.6 (range, 1 to 60) months. These patency rates were comparable with previously reported rates for conventional open surgery.[8] Fukui et al.[12] also reported similar mid-term patency rates with a primary patency of 87% and secondary patency of 93% at three years.

Furthermore, in a multi-center, randomized-controlled trial published by Tiek et al.,[6] although the mean operation time was longer for the laparoscopic approach than the conventional method (4 h 19 min [2 h 00 min to 6 h 20 min] vs. 3 h 30 min [1 h 42 min to 5 h 11 min], respectively; p=0.101), postoperative recovery and length of in-hospital stay were significantly shorter after laparoscopic surgery. Moreover, oral intake could be restarted earlier (mean 20 h 34 min [6 h 00 min to 26 h 55 min], respectively vs. 43 h 43 min [19 h 40 min to 77 h 30 min], respectively; p=0.00014) as well as postoperative mobilization (mean 46 h 15 min [16 h 07 min to 112 h 40 min] vs. mean 94 h 14 min [66 h 10 min to 127 h 23 min], respectively; p=0.00016). The length of hospitalization was shorter (mean 5.5 days vs. mean 13.0 days, respectively; p=0.0095). Visual pain scores and discomfort scores were also lower after laparoscopic surgery. Until that time, there was no strong evidence that laparoscopic aortic surgery was less invasive than and as effective as conventional surgery. After the publication of this comparative study, totally laparoscopic aortobifemoral bypass surgery has been thought to be a safe approach with reduced postoperative morbidity rates, shorter length of in-hospital stay, and better postoperative recovery.

Long-term outcomes

Although laparoscopic aortobifemoral bypass surgery attracted great interest initially, due to improvement of endovascular surgery, the expected increase in the number of centers performing laparoscopy was not observed in the following years. Therefore, few studies have been conducted with long-term outcomes. Ghammad et al.[13] reported patency rates at three and five years as 97% and 85%, respectively. Moreover, the median operation time was 205 (range, 120 to 420) min, the median aortic clamp time was 50 (range, 20 to 120) min, and the mean blood loss was 263 (range, 0 to 3,200) mL in their study. In an another study conducted by Lecot et al.[14] recently, graft limb-based primary, primary assisted, and secondary patency rates were 96.1%, 98.1%, and 99.4% at one year, respectively and 83.0%, 92.0%, and 97.0% at five years, respectively. Postoperative mortality was seen in only 1.1% of patients. There were no graft infections. The overall conversion rate in this series was 20.6%.[14] According to a meta-analysis of all open aortobifemoral bypass studies for occlusive disease with long-term follow up published between 1970 and 1996, de Vries and Hunink[15] calculated the five-year limb-based patency rates to be 91.0% for intermittent claudication and 87.5% for patients with critical limb ischemia. These patency rates are identical to those in the present laparoscopic surgery series.[7-14] On the other hand, Ricco et al.[16] suggested that, even with a well-trained surgical team, the laparoscopic approach increased the risk for adverse events observed in the course of aortic surgery.

In the literature, there is only one systematic review available. Helgetveit and Krog[17] published this paper in 2017 and 66 studies were deemed eligible, while only 16 of them met the inclusion criteria for the quantitative synthesis. The study population consisted of 588 patients undergoing totally laparoscopic aortobifemoral bypass: 22 for an abdominal aortic aneurysm, and the remaining 566 for an aortoiliac occlusive disease. Five comparative studies regarding aortoiliac occlusive disease compared 211 totally laparoscopic procedures with 246 open procedures. As expected, the mean operation and

aortic cross-clamp times were shorter in the open group. The conversion rates ranged from 0 to 27%. There was no statistically significant difference in the mortality rate between the two groups (p=0.64). The length of hospital stay ranged from 4.0 to 12.1 days and 5.0 to 12.8 days in the laparoscopic group and open group, respectively. The authors concluded that totally laparoscopic aortoiliac surgery seemed to be a feasible technique with unaffected mortality and trend toward benefits in hospital stay and also in complication rates.

Learning curve

Total laparoscopic vascular surgery is more challenging for the surgeon. The complexity of the surgical technique, particularly completion of the anastomosis, is indicated by a considerable learning curve. Remy et al.[18] reported that a learning curve affected their outcomes with a significant reduction in aortic clamp time and mean operation time. Fourneau[19] also drew attention to the importance of the learning curve to achieve more favorable operative variables such as operation time, aortic clamp time, amount of blood loss, and conversion to laparotomy. The authors suggested that the number could be set at 25 to 30 procedures.

Comments

Despite an international consensus for the management of peripheral disease recommending aortobifemoral bypass as the procedure of choice for most patients with severe aortoiliac occlusive disease, endovascular options have currently become the first approach of vascular surgeons for nearly all aortoiliac lesions (TASC II A to D). However, surgery is still needed in selected cases with more than 20-cm iliac occlusion TASC D or complex bilateral lesions with a high probability of placement of numerous stents due to high cost. Moreover, if endovascular surgery has failed, aortobifemoral bypass can be the only choice.

Although promising results have been described demonstrating the feasibility of totally laparoscopic aortic surgery, the widespread use of this technique remains relatively low. There are few centers adopting the procedure all around the world. According to the published studies, it seems quite evident that laparoscopic surgery for aortoiliac occlusive disease is related to longer operating and clamping times; however, significant differences were obtained in favor of shorter hospital stay, shorter recovery times, faster return to normal daily activities, and lower pain scores in the laparoscopic group. The amount of intraoperative blood loss and postoperative morbidity rates were less conclusive, while there is a tendency toward less postoperative complications in the laparoscopic group. These improvements in the peri- and early postoperative variables are the main strengths of laparoscopic aortobifemoral bypass over open surgery.

Regarding to the patency rates of laparoscopic approach, acceptable early results have been achieved in multiple case series. Primary, primary-assisted, and secondary patency rates are also identical to open aortobifemoral bypass series in the long-term.[7-14] Overall, most studies provide evidence that laparoscopic surgery is comparable with open surgery in terms of survival. The mortality rates are less than 2% in case series and similar to studies for open aortobifemoral bypass. Satisfactory results in these operative and postoperative data are directly linked to the number of interventions previously performed and the laparoscopic experience of surgeons. Therefore, a considerable learning curve is mandatory.

Based on the aforementioned findings, we believe that laparoscopic aortobifemoral bypass is not only an alternative to open surgery, but it has also a potential to be the first treatment choice for patients with extensive aortoiliac occlusive disease in this period of increasing interest in minimal invasive surgery. However, particularly due to a difficult learning period, it is still not widely preferred.

In conclusion, there are no published satisfactory reports directly comparing laparoscopic aortobifemoral bypass with endovascular treatment for extensive aortoiliac occlusive disease in the endovascular era. Recently, Pascarella et al.[20] underlined that high-quality evidence is lacking regarding the further feasibility of these techniques and their applicability in general practice compared to endovascular therapies at this moment. However, the following question should be kept in mind: Can laparoscopic aortobifemoral bypass challenge to endovascular treatment as the primary treatment modality for these group of patient? Finally, there is a distinct need for further large-scale, randomized studies to confirm the benefits of laparoscopic aortobifemoral bypass surgery.

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