Early Experiences of Laparoscopic Aortofemoral Bypass in Korea—report from a Single Center

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Although endovascular approach can be widely applied to occlusive aortoiliac segment, aortofemoral bypass (AFB) continues to offer superior long term patency. In an effort to reduce the morbidity of AFB, LAFB (laparoscopic AFB) has been developed. We report our initial experiences to determine the feasibility and safety. From September 2005 to May 2008, LAFB was performed in 12 patients. A transabdominal retrocolic approach with pneumoperitoneum or direct approach was preferred. LAFB consisted of aortic dissection, vascular control with or without intracorporeal anastomosis. Last two cases were performed using da Vinci system for secure proximal anastomosis as an end to side fashion. Laparoscopic procedures were successfully performed in 11 patients. One patient underwent open conversion due to small bowel injury and bleeding. Mean operating time and aortic clamping time was 446 minutes and 87.5 minutes. The time to return of bowel function was about 2.1 days (2.1 ± 1.2). Compartment syndrome was developed in one patient at immediate postoperatively. During this study period, operating time was shown in decreasing tendency. Although LAFB is challenging procedure with steep learning curve, it is feasible technique and appears to ease patient's postoperative course.

Key words: laparoscopy, aortofemoral bypass, atherosclerosis

INTRODUCTION

Endovascular treatment is widely applicable to TASC A, B, C and even D aortoiliac occlusive lesions. Many patients prefer to minimal invasive techniques to avoid postoperative pain and delay functional recovery. However, aortofemoral bypass (AFB) grafting is very durable procedures to offer superior long term patency in severe atherosclerotic lesion which may not be amenable to percutaneous techniques. Thus, the basic concept of LAFB conveys advantages of standard reconstruction such as durability and laparoscopic procedures such as minimal pain, quick recovery, and cosmetic effect. However, LAFB may have some disadvantages including long operative time, steep learning curve, and absence of tactile feedback. In 1993, Dion et al. were the first to describe a laparoscopy assisted AFB, which consisted of aortic dissection, graft positioning, and small incision with conventional suturing. A number of operative techniques were developed from several centers and adopted steadily in the world. Furthermore, several hybrid methods such as combination among laparoscopy, robotic and endovascular techniques have developed toward minimal invasiveness of patients. We performed this procedure since 2005 toward minimal invasive approach to aortic disease.

MATERIALS AND METHODS

Between September 2005 and May 2008, 12 patients (mean age: 68.3) underwent laparoscopic aortic recon-
struction (laparoscopic assisted in 5, totally in 5, robotic assisted in 2). Among them, three patients underwent infrainguinal reconstructions simultaneously (Table 1). All patients were referred for aortoiliac occlusive disease, and their aortoiliac occlusive lesions were TASC C or D, which could not be recommended by angioplasty or stenting. Patients who had previous major abdominal surgery or circumferential aortic calcification were excluded for this procedure. The operative indications were resting pain in 2, ischemic ulcer in 1 and incapacitating claudication in 9.

Positioning and techniques: The patient was placed in the modified right lateral decubitus position with left arm elevation on a rest. The operating surgeon was positioned on patient’s left side at first four cases, but moved right side after. A 1 cm periumbilical incision was made and an 11 mm port was introduced under direct vision for camera, which was insufflated with carbon dioxide to a pressure of 13 mmHg. Four or five additional 10 mm trochars were inserted as shown Fig. 2. The laparoscopic techniques consisted of aortic dissection, vascular control with/without intracorporeal anastomosis (totally, assisted). Aorta dissection was performed in retrocolic plane in first four cases, however, for next 7 cases, we used retrocolic and retrorenal plane for more stable visualization of pararenal aortic segment. Briefly, a left retrocolic dissection was conducted in line of the Todd fascia of sigmoid, up to spleen. Left hemicolon and splenic flexures, and left kidney were mobilized medially. Laparoscopic dissection was carefully continued at left common iliac artery and isolated left ureter. After then, dissection was moved upward till renal artery around anterior or lateral surface of aorta with coagulation or harmonic scalpel. After achieving the dissection, the operating table was rotated on the left and each femoral artery was dissected in the usual manner. The vascular prosthesis was introduced in the abdomen through one of the trocars. A long curved atraumatic grasper was inserted in the groin and gently moved though the retroperitoneum under video control. The graft limb was then grasped and pulled down to the groin. The retroperitoneum was closed with a running suture, preventing direct contact of the intestine with the graft. For laparoscopic assisted procedure (Fig. 1), a laparoscopic aorta cramp (Stortz, Germany) was inserted through upper port incision site, and graft was introduced and positioned for anastomosis. After then, mini-laparotomy incision was made from extension of appropriate trocar site, which was selected for stable exposure for anastomosis. We have used several narrow retractor through laparotomy incision during anastomosis (Fig. 1A). The aortic anastomosis was performed extracorporeally using a running 3-0 prolene suture. For totally laparoscopic procedure (Fig. 2), the anastomosis was performed with two continuous 3-0 prolene sutures, which were tied intracorporeally during aorta clamping (proximal: laparoscopic aorta clamp, distal: laparoscopic bulldog (end to side) or aortic trans-section with endoGIA (end to end). For the robotic surgery, direct retroperitoneum over the aorta was opened on the left side of the aorta from bifurcation to the renal vein (Fig. 3).

**RESULTS**

The patients consisted of 10 men and two women. The

<table>
<thead>
<tr>
<th>Sex/Age</th>
<th>Type of surgery</th>
<th>op time (min)</th>
<th>Aorta clamping time (min)</th>
<th>gas out (POD)</th>
<th>Outflow procedure</th>
<th>Preop ABI</th>
<th>Postop ABI (right/left)</th>
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<td>695</td>
<td>77</td>
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<td>1</td>
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<tr>
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<td>405</td>
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<td>453</td>
<td>115</td>
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<tr>
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<td>425</td>
<td>98</td>
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<td>0.54/0.77</td>
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<td>430</td>
<td>76</td>
<td>2</td>
<td>Fem-pop</td>
<td>0.49/0.22</td>
<td>1.08/0.99</td>
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<td>385</td>
<td>64</td>
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Fig. 1 Laparoscopic assisted aortofemoral bypass. A: Minilaparotomy incision for proximal anastomosis is about 5 cm from adjacent port site. B: Aorta cross-cramping for end to side anastomosis. C: Postoperative CT angiography demonstrates patent bypass graft. D: Operative wound after 1 year.

Fig. 2 Totally laparoscopic aortofemoral bypass. A: Sites of trocar insertion. B: Operative picture showing proximal aorta clamping and intracorporeal anastomosis with prolene (end to end). C: Postoperative CT angiography demonstrates patent bypass graft. D: Operative wound.
age of patients ranged from 53 to 78 years (mean age, 68.3 years). Median follow-up were 15 months (range: 1–28 months). Operative indications were severe claudication in 9, resting pain in 2, and ischemic ulcer in 1. Mean preoperative ABI was 0.50/0.54 (right/left). We have completed LAFB in 11 out of 12 patients (aorto-bifemoral bypass in 11, aortounifemoral bypass in 1). Type of proximal anastomosis was end to side in 4, end to end in 8. One patient was converted to a minilaparotomy because of small bowel injury and troublesome bleeding (Table 1). Three patients underwent simultaneous infrainguinal reconstruction (femoropopliteal bypass in 2, femorotibial bypass in 1). Mean operative time was 446 minutes (range: 225–695 minutes). Mean aortic clamping time was 87.5 minutes (range: 55–130 minutes). Major complication occurred in one patient with compartment syndrome. This 75-year-old man presented resting pain with multilevel occlusive disease on preoperative angiography. After LAFB (aorta clamping time: 130 minutes), patient complained of more aggravated leg pain. We performed immediate infrainguinal bypass. However, compartment syndrome occurred finally, which needed emergent fasciotomy. Most of patients seem to have minimal postoperative pain, quick recovery of bowel function (mean: 2.1 days) compared to conventional surgery (mean: 3.3 days) in our previous study.

**DISCUSSION**

Although the conventional aorta surgery is durable procedure, it may afford several disadvantages such as massive fluid shift, hypothermia, ileus, and severe pain after operation, which might be related with delayed functional recovery. The laparoscopy is widely used in other surgical specialties such as cholecystectomy, gastrectomy and colon resection; however, it has not been generalized over the world yet in vascular surgery because of technical challenge of obtaining wide aortic exposure, and secure anastomosis. Another reason for this is favorable results of endovascular treatments as a strong competitor of minimal invasive modality for aortoiliac occlusive disease. However, those with diffuse disease may be considered for AFB. Therefore, the goal of LAFB is to prove similar result of open AFB with the advantages of minimally invasive techniques.

In the early reports comparing the open cholecystectomy with the laparoscopy cholecystectomy in terms of the minimal invasiveness, the stress reaction is known to be
scopic assisted procedure was more difficult to perform and prolonged recovery. In our studies, we observed that mean temperature during operation in LAFB is 35.1˚C ± 0.9 (open: 34.5˚C ± 1.9).

The first totally laparoscopic aortofemoral bypass was performed by Dion et al. in 1995. Since then, several different techniques were published with favorable results for the patients who have critical aortic aneurysm as well as occlusive lesions. This technique must be still evolving now because others have successfully performed in more complicated cases. According to early studies from Coggia, et al. and Olinde, et al., they also found that operating time decreased after performing more than 10 cases of LAFB. However, we did not reach any improvement in term of operating time. One reason is that our technique have been changed, because we believe that laparoscopic assisted procedure was more difficult to perform with safety even we did successfully first five cases. Presently, totally laparoscopic AFB was more comfortable to accomplish it rather than assisted procedure. However, intracorporeal anastomosis still requires long aortic clamping time to get finished. Therefore we adopted robotic assisted suture to shorten clamping time, especially dedicated on end to side anastomosis of aortoprosthetic. The other reason is that the fear of exposing the patients to harmful outcome hesitate us liberally to apply for this procedure during the learning curve. Recent study suggested that the learning curve could be set at 25–30 cases. Obviously, we are still in the middle of learning curve, however, most detail procedures are comfortable now and we are generously apply this for patients who need aortofemoral bypass without patient selection. Although we did not get any improvement in operation time in our series, our procedures such as fine dissection, better aorta exposure, and stable suture have evolved serially.

We think that LAFB has several technical difficulties including obtaining wide uninterrupted aorta exposure, secure intracorporeal suture, and help of excellent scopes. To overcome those problems, first of all, port location is carefully selected according to body status of patient and aorta lesion. Another concern is that when anastomosis of aorta-prosthesis graft starts in continuous fashion, prolene suture should not be injured as pulling the suture to avoid further anastomosis breakage. To avoid this catastrophic situation, we put the several reinforcement stitches with pledget. Secondly, the role of scopes is very important because visual acuity is everything to perform safe procedure.

In conclusion, LAFB is a viable option for diffuse aortoiliac occlusive disease. Compared with previous conventional AFB, LFFB have shown less pain, minimal postoperative bowel functions. With more experience and advanced technologies, laparoscopy aorta surgery will have evolved in the future.

REFERENCES

10) Stádler P, Matous P, Vitásek P, Spacek M. Robot-


