Hand-assisted Laparoscopic Aortobifemoral Bypass for Occlusive Disease. Early and Mid-term Results

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Objectives. To evaluate the early and mid-term results of hand-assisted laparoscopic surgery (HALS) for aorto-iliac reconstruction.

Design. Prospective survey.

Materials and methods. Between February 2002 and January 2004, 46 patients received an aortobifemoral bypass for advanced occlusive disease by HALS.

Result. There was one conversion to open surgery. Mortality was 4.5%. The median return to solid oral diet took 36 h (24–182), the median hospital stay was 5 days (3–26). Primary patency rate at 1 year was 97.5%. The incidence of incisional hernia was 19.5%.

Conclusions. HALS aorto-iliac reconstruction should be considered as a minimal invasive technique with good early and mid-term results.

Keywords: Hand-assisted laparoscopy; Aortobifemoral bypass; Aorto-iliac occlusive disease; Minimal invasive surgery.

Inspired by the good results of abdominal laparoscopic procedures a few pioneers adopted these laparoscopic techniques for reconstruction of the aorta with promising results. However, totally laparoscopic and laparoscopically assisted aortic surgery remains technically demanding. This explains the rather slow introduction of minimal-access aortic surgery in the vascular surgical world. In anticipation of increasing surgical experience and better instrumentation that will make totally laparoscopic aorto-iliac surgery more accessible for the average vascular surgeon, hand-assisted laparoscopic surgery (HALS) was introduced as a valuable intermediate approach. To facilitate our learning process of totally laparoscopic aortic surgery, we started with hand-assisted laparoscopic aortobifemoral reconstructions for severe aorto-iliac occlusive disease. The aim of this article is to share this experience.

Materials and Methods

HALS was introduced at our department in February 2002. Between February 2002 and January 2004, 46 patients without history of major abdominal surgery received an aortobifemoral bypass by HALS and were followed prospectively. The indication for aortobifemoral bypass was extended aorto-iliac occlusive disease requiring bypass surgery.

A supra-umbilical midline incision is made, the length being determined by the size of the surgeons hand. Two 10 mm trocars are inserted, one in the midline hypogastrium and one in the left iliac fossa. The minilaparotomy is sealed with a Handport® (Smith and Nephew, Andover, MA 01810, USA) or Gelport® (Applied Medical, Rancho Santa Margarita, CA 92688, USA) and a pneumoperitoneum of 12 mmHg is applied (Fig. 1). The patient is put in a 30° Trendelenburg position and tilted slightly to the right. For the HALS technique the surgeon is standing on the right side and the assistant on the left side of the patient, holding the camera. The non-dominant hand of the surgeon enters the abdomen through the sealed minilaparotomy. The dorsal peritoneum is opened and the infrarenal aorta is dissected free using a combination of blunt digital dissection and harmonic scalpel. Retroperitoneal tunneling to the groins is performed by blunt digital dissection. After finishing the dissection the pneumoperitoneum is deflated and an orthostatic retractor is put in place. Through the minilaparotomy, the aorta is clamped using a flexible clamp (Cosgrove Flex Quick®, Edwards Lifesciences,
Irvine, CA 92614, USA) and the proximal anastomosis is performed using conventional vascular instruments, in either end to end or end to side fashion (Fig. 1). The graft is pulled to the groins and the distal anastomoses are performed. After completion of the distal anastomoses, the dorsal peritoneum is closed through the minilaparotomy using conventional instruments. A completion laparoscopy is performed to inspect the abdominal cavity.

Data analyzed in this study included patient demographics (age, gender, body mass index (BMI), cardiovascular risk factors, ASA score, TASC classification, symptoms), operative data (incision length, operative time, clamping time, estimated blood loss, body temperature change), patient recovery data (time to return to fluid diet, time to return to solid diet, time to ambulation, time to discharge, in-hospital mortality and morbidity), as well as mid-term clinical results.

Results

Patient demographics are summarized in Table 1. All patients presented with disabling claudication ($n = 40$) or rest pain ($n = 6$). The mean ankle-brachial index at rest was 0.58 and 0.25 after exercising. MRI or arteriography demonstrated severe aorto-iliac occlusive disease in all cases: 10 patients could be classified as TASC C and 36 patients as TASC D. Fourteen patients presented with recurrent symptoms after previous aorto-iliac endovascular procedures. One patient had already been treated endovascularly four times.

All but one procedure was completed by the hand-assisted laparoscopic technique. In one patient conversion to midline xyphopubic laparotomy was necessary because of non-rotation of the bowel. As the postoperative course of this patient was uneventful, she was excluded for further analysis. The operative data of the remaining 45 patients are summarized in Table 2. Fig. 2 shows the evolution of the operative time (a) and clamping time for a end to side anastomosis (b) with growing experience. When appreciating the total operation time, it should be noticed that in half of the patients a profundaplasty was associated. In two patients extensive division of adhesions was needed. In one patient an additional above knee femoro-popliteal bypass was performed. The operative time of this patient was therefore not inserted in the figure.

Early recovery data are summarized in Table 3. The in-hospital mortality was 4.5%. One patient died 6 weeks postoperatively of multiple organ failure. Another patient developed sudden death on the 4th postoperative day, the day before planned discharge; autopsy could not find the cause. Other early postoperative complications were subendocardial infarction ($n = 1$), pneumonia ($n = 1$), transient deterioration of renal function ($n = 1$), bleeding gastric ulcer ($n = 1$), cholesterol embolization to the left foot ($n = 1$), deep venous thrombosis of the femoral vein ($n = 1$), delayed wound healing in the groin ($n = 2$) and abdominal wall hematoma ($n = 2$). All these patients were treated conservatively with complete recovery.

Three patients were readmitted soon after discharge. One patient was readmitted 3 weeks postoperatively because of sub-acute bowel obstruction, which resolved completely under conservative therapy. Another patient was readmitted 3 weeks postoperatively because of left pyelonephritis, which needed a pyeloplasty. One patient developed pulmonary oedema 2 weeks after discharge which needed readmission to the coronary care unit.

With two patients deceased and two patients lost to follow-up, 41 patients were available for analysis of mid-term results. The mean follow-up was 19.5 months (12–34). All patients appreciated the good cosmetic result (Fig. 3). All aortobifemoral grafts remained patent except one, giving a patient related primary patency rate at 1 year of 97.5%. This patient developed occlusion of the right limb 1 year postoperatively. As he presented only several weeks after recurrence of symptoms, he was treated with a femoro-femoral cross-over bypass. Two other patients needed vascular reintervention: one patient needed
Table 1. Patient demographics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years, mean)</td>
<td>58.7 (41–76)</td>
</tr>
<tr>
<td>Gender (M/F) (n)</td>
<td>31/15</td>
</tr>
<tr>
<td>BMI (mean)</td>
<td>24.6 (18.6–29.6)</td>
</tr>
<tr>
<td>Smoking (n)</td>
<td>41</td>
</tr>
<tr>
<td>Diabetes (n)</td>
<td>4</td>
</tr>
<tr>
<td>ASHD (n)</td>
<td>15</td>
</tr>
<tr>
<td>Hypercholesterolemia (n)</td>
<td>20</td>
</tr>
<tr>
<td>Hypertension (n)</td>
<td>18</td>
</tr>
<tr>
<td>ASA score (I/II/III) (n)</td>
<td>3/26/17</td>
</tr>
<tr>
<td>TASC classification (A/B/C/D) (n)</td>
<td>0/0/10/36</td>
</tr>
</tbody>
</table>

* ASHD, atherosclerotic heart disease.
† ASA score, American Society of Anaesthesiologists score.
‡ TASC classification, Transatlantic Inter-society Consensus (TASC) on management of peripheral arterial disease.

Table 2. Operative data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>HALS n = 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incision length (cm, mean)</td>
<td>5.9 (4.5–7.5)</td>
</tr>
<tr>
<td>Type of proximal anastomosis (E-to-E/E-to-S) (n)</td>
<td>7/38</td>
</tr>
<tr>
<td>Duration of operation (min, mean)</td>
<td>208 (155–300)</td>
</tr>
<tr>
<td>Clamping time for E-to-S anastomosis (min, mean)</td>
<td>28.4 (15–55)</td>
</tr>
<tr>
<td>Clamping time for E-to-E anastomosis (min, mean)</td>
<td>69.1 (55–86)</td>
</tr>
<tr>
<td>Estimated blood loss (ml, mean)</td>
<td>776 (100–2500)</td>
</tr>
<tr>
<td>Body temperature change at termination (°C, mean)</td>
<td>+0.5 (−0.3 ± 1.2)</td>
</tr>
</tbody>
</table>

* Clamping time until revascularization of the first limb.

Discussion

The operative morbidity of aorto-iliac reconstructions is mainly related to the surgical trauma derived from the extensive abdominal incision and dissection and not to the arterial reconstruction itself.\(^4^,^5\) A possible strategy to reduce the morbidity of the procedure could be to minimize the access without changing the type of reconstruction itself. For this purpose a totally laparoscopic approach for aorto-iliac reconstructions has been developed.\(^6^,^7\) However, totally laparoscopic aortic surgery remains a very demanding procedure. Although promising in the hands of experienced and dexterous laparoscopic surgeons, the highly specific technical skills explain the slow introduction of this technique.

HALS responds to many of the drawbacks of totally laparoscopic aortic procedures. The ability to use the hand for retraction and blunt dissection greatly facilitates these operations. Most important, the tactile senses of the surgeon are preserved. Palpation of the aorta is possible, and cross-clamping of the aorta can be performed with much greater confidence than in totally laparoscopic procedures. Moreover, using an orthostatic retractor the mini-incision permits the surgeon to use conventional clamps and needle holders to perform the aorto-prosthetic anastomosis. All these factors break down the barriers substantially.\(^8\) Although we started the HALS-program with only very basic experience in laparoscopy, conversion was needed in only one out of 46 patients. Analysis of the total operation time and cross-clamping time shows that over 45 cases, there is almost no shortening, demonstrating that a learning curve is not present (Fig. 2).

Moreover, starting minimal-access aortic surgery with HALS breaks down the barrier for a totally laparoscopic approach. It also helps to reduce its learning curve as it familiarises both the surgical and the nursing staff with laparoscopic principles and materials. This is especially true in countries where vascular surgery is performed by specialized vascular surgeons, not familiar with laparoscopic surgery. But, although helpful in breaking down the barrier for a totally laparoscopic approach, it should be realised that the skills needed for HALS are different than those needed in total laparoscopy.

As HALS still requires a minilaparotomy one may doubt why laparoscopy is necessary at all.\(^9\) However, adding laparoscopy to the minilaparotomy reduces the incision length and adds safety to the procedure. In procedures performed through a small laparotomy alone, essential structures are excluded from the visual field with potential risk of injury and local
It might be underlined that in our series none of the complications were related to hidden lacerations due to a lack of visibility. This stresses the importance of the completion laparoscopy at the end of the procedure.

Since, HALS still requires a minilaparotomy skepticism arises about whether the procedure is still less invasive compared with conventional open aortic surgery. Analysis of the early recovery data shows satisfying results with early return to oral diet and ambulation and short in hospital stay (Table 2). Some large, but non-randomized series in the urological field, i.e. comparing HALS with open surgery confirm these findings. Kelly et al. compared eight HALS aortobifemoral grafts with a contemporary cohort of 10 conventional aortobifemoral grafts. They came to the conclusion that HALS may result in shorter hospitalization, more rapid recovery of bowel function, and earlier return to activity. We admit, however, that to clarify this with a higher level of evidence a prospective randomized study comparing HALS with conventional open aorto-iliac reconstruction is required.

One concern regarding HALS is the continuous stress on the wound edges throughout the procedure, which may predispose to wound healing problems. However, in contrast with the experience of some urologists, no early wound healing problems at the site of the minilaparotomy were seen. In our series with a mean follow-up of 19.5 months, the incidence of complications.

Fig. 2. Evolution of the operative (a) and anastomotic time (b) with growing experience.
Incisional hernia was 19.5%. This seems high, but is in accordance with the incidence of incisional hernia found in large prospective studies of conventional aorto-iliac reconstruction. Maybe, the systematic use of a polypropylene mesh could help to reduce the rate of incisional hernias.

With a primary patency rate of 97.5% at 1 year mid-term results are comparable with those of conventional aorto-iliac reconstructions. HALS should be considered as a useful tool to help overcome the learning curve of totally laparoscopic aorto-iliac surgery and as a adjunct for those cases not amenable to the total laparoscopic approach.

References


