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ORIGINAL ARTICLE

Mini-invasive aortic surgery: a 2 year experience

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Abstract. The aim of this study was to evaluate a less invasive technique for the exposure of the infrarenal aorta and its impact on the treatment of patients with abdominal aortic aneurysms (AAA). Fortyfour patients with AAA were prospectively selected for minilaparotomy aortic exposure and repair using a small periumbilical midline incision, intra-abdominal nondisplaced retraction of the small bowel and conventional hand-sewn vascular anastomosis. Perioperative comparisons with a contemporary group of AAA patients treated with long, open midline incision and extracavitary small bowel retraction were made. There were no significant differences between the minilaparotomy and open surgical control group concerning operating room time, intraoperative and perioperative morbidity or mortality. Significant differences were shown between the two groups regarding intensive care unit stay; the return to a general diet and the length of hospitalization. Minilaparotomy exposure is safe and effective for the treatment of infrarenal AAA. This technique maintains quality outcome while reducing postoperative ileus, hospital stay and resource utilization.

Key words: Vascular surgery, aortic surgery, abdominal aortic aneurysm, AAA, mini-invasive surgery, minilaparotomy

Introduction

Since the first operations by Dubost, DeBakey and later Creech, (1-3) the surgery of abdominal aorta aneurysms (AAA) has witnessed enormous progress in the anaesthesiological, technic-instrumental and organizational fields (4). There have been only slight changes in the surgical technique, which has remained more or less the same as that of its pioneers. The last decade has seen the development and confirmation of the endovascular method (5, 6), which arose out of the need to find, as for other surgical specialities (7), a mini-invasive approach to aortic surgery, although, at a distance, the complications following this methodology are beginning to have a limiting effect on its indications (8-10). Therefore from January 2002, our team has turned its attention to alternative mini-invasive techniques (MIS) and in particular to minilaparotomy (MLP) and to Hand Assisted Laparoscopic Surgery (HALS), since we consider the totally laparoscopic technique too demanding. We have therefore evaluated the efficacy and the possible advantages of mini-invasive aortic surgery versus traditional surgery.

Materials and Methods

Surgical technique. Our aortic approach by means of minilaparotomy is not very different from that described by Cerveira and Turnipseed (11, 12): the patient is positioned so as to achieve a hyperextension of the lumbar rachis, thus exposing the aneurysm; he is placed in a slightly anti-Trendelenburg position and turned on his right side. Once the anaesthesia has been induced and the patient curarised, the

aneurysm is palpated on the fully relaxed wall; its profile is drawn and a cutaneous incision line is made 8 to 10 cm in length, including the aneurysmatic sac in its entirety: generally, the incision is periumbilical, continuing above or below as needed (Figure 1). When the incision has been made and the peritoneum opened, the intestinal loops are pushed towards the right hemiabdomen using a wet gauze; a special retractor (Protractor) for the abdominal wall is inserted, and a Parks self-retractor and two valve separators connected to two Martins are positioned. The aneurysm is then isolated and, after heparinisation, clamping is performed using normal clamps (often the occlusion of the iliac arteries is achieved by means of a Foley's catheter) (Figure 2). Once the aneurysmatic sac is opened, routine endoaneurysmorrhaphy is performed with a prosthetic graft by end-to-end anastomosis, using sufficiently long instruments (Figure 3). The HALS technique is the same as described by Kolvenbach (13), partly because, with our collaboration, he himself carried out the first HALS procedure performed in our Operating Unit.

From January 2002 to December 2003, 125 elective aortic surgical procedures were carried out at the Vascular Surgical Department of the Hospital of Parma for AAAs: 25 (20%) with the traditional method (TAS), 67 (53,6%) with a mini-invasive technique and 33 (26,4%) by means of endovascular exclusion. Of the procedures carried out with the MIS technique, 65 were performed by means of minilaparotomy, and 2 using HALS. There were no significant differences, aside from age, between the group of patients treated with MIS and those treated with TAS (Table 1), regarding sex, weight, height, diameter of the aneurysm, anaesthesiological classification (ASA) and associated pathologies.

With the mini-invasive method, there were 50 (74,6%) aorto-aortic, 15 (22.4%) aorto-bisiliac and 2 (3%) aorto-bifemoral grafts. With TAS there were 5 (20%) aorto-aortic, 18 (72%) aorto-bisiliac and 2 (8%) aorto-bifemoral grafts respectively.

In two cases in both groups associated procedures were also carried out (MIS: 1 cholecystectomy, 1 resection/graft for aneurysm of the deep femoral artery; TAS: 1 cholecystectomy, 1 plastic surgery procedure for laparocele).

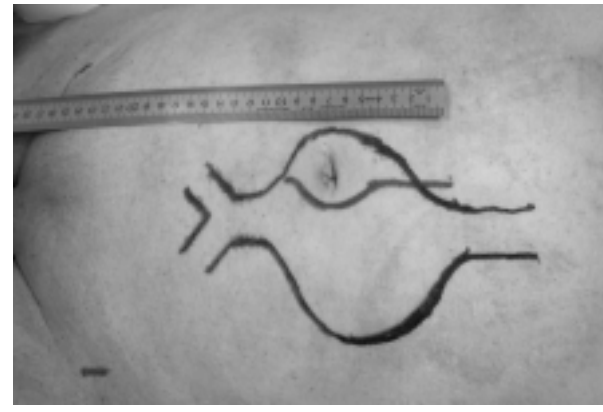

Figure 1. Cutaneous incision line with aneurysm profile drawn

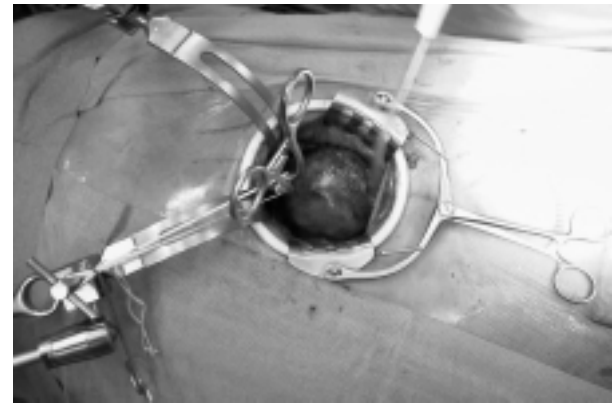

Figure 2. Clamped aneurysm

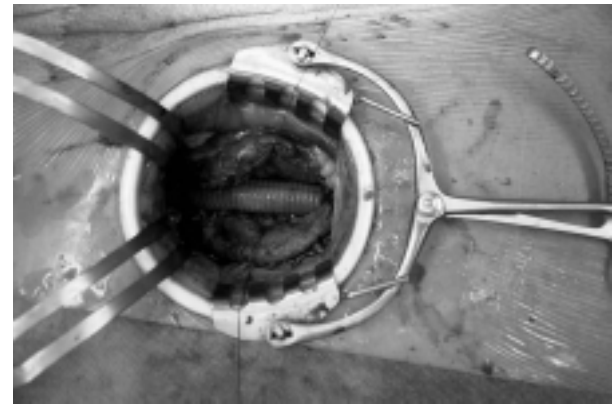

Figure 3. Aorto-aortic prosthetic graft

Perioperative analgesia was achieved by positioning a peridural catheter at T10-T12 level, with the infusion of 0.2% ropivacaine (Naropine).

Table 1.

	MIS	TAS
Total no. of patients	67	25
Age	64.6 (51-81)	72.7 (52-81)
Sex		
M	59	20
F	8	5
Mean height (cm)	170.4	173.2
Mean weight (kg)	76.9	78.5
Diameter of aneurysm (cm)	6.2 (4.5-7.7)	6.3 (4.6-8.0)
Mean ASA	2.7 (2-3)	2.6 (2-3)

We analysed the results obtained in the immediate post-operative period by further dividing the MIS group into 2 groups: the first group consisted of 21 patients operated on in the first 9 months of our experience (MIS I) and the second group consisted of 46 patients operated on in the following 15 months (MIS II); in fact from September 2002 onwards we modified our post-operative protocol, removing the nasogastric tube and suspending antalgic therapy on day one, and starting the patient on liquids on day two.

Results

The mean duration of surgery was 170 minutes (135–210') for the MIS group, and 178 (120-350) for the TAS group. Mean blood loss was 1250 ml (500-3000) for the mini-invasive procedures, and 1200 ml (500-2000) for the traditional procedures.

After surgery, all patients were placed for 24 hours in the post-operative intensive care unit (ICU) where their tubes were removed during the first three hours. Three patients in the MIS group had their tubes removed in the operating room and were sent to the ward after being monitored for 4 hours.

The tube was removed after a mean of 1.5 days (range 0-5) in the MIS group (2.2 days, range 1-5 MIS I; 1 day, range 0-1 MIS II), and a mean of 2.5 days (range 1-4) in the TAS group. The introduction of solids was resumed after a mean of 2.9 (1-5) days in the MIS 1 group, and canalization, in the same group, was resumed on average on day three (2-6), whereas solids were routinely resumed in the MIS II group on day 2 and canalization after a mean of 2.3 days (2-6), and after 3.1 (3-4) days and 3 (2-4) days respectively in the TAS group. Active mobility was resumed after a mean of 2.4 days in both groups (2-5 MIS I, 2-4 MIS II) and after a mean of 3 days (2-6) in the TAS group. One patient treated by means of minilaparotomic access died of cardiac arrest in ICU 2 hours after surgery; another patient of the same group suffered from a self-limiting retroperitoneal haematoma. One patient who had conventional surgery underwent surgery again on the third day due to iatrogenic stenoobstruction of an ureter.

The mean post-operative hospital stay was 6.7 (4-12) days for the MIS I group, 5,9 (4-8) days for the MIS II group, and 7.6 (6-9) days for the traditional method group. (Table 2)

Discussion

Traditional surgery of abdominal aorta aneurysms has, over the years, proved to be effective, with excellent results at a distance; however, the perioperative

Table 2.

	MIS I	MIS II	TAS
Duration of surgery (minutes)	170 (135-210)	170 (135-210)	178 (120-350)
Blood loss (ml)	1250 (500-3000)	1250 (500-3000)	1200 (500-2000)
Removal of NGT (days)	2.2 (1-5)	1 (0-1)	2.5 (1-4)
Resumption of solids days	2.9 (1-5)	2 (1-3)	3.1 (3-4)
Resumption of canalization (days)	3 (2-6)	2.3 (2-6)	3 (2-4)
Resumption of active mobility (days)	2.6 (2-5)	2.4 (2-4)	3 (2-6)
Perioperative complications	1 (4.7%)	0	1 (4%)
Mortality	0	1 (2.3)	0
Discharge (days)	6.7 (4-12)	5.9 (4-8)	7.6 (6-9)

mortality rate remains, even in the most qualified centres, around 2-3% (14-16). Presently, with the ever increasing age and morbidity of the treated patients, the objective of aortic surgery is to achieve an improvement in the quality of the post-operative hospital stay and an earlier discharge of the patient. Although the endovascular method has been proved to be less invasive, it nevertheless presents numerous problems on account of its limited indications, its persistently high costs, the demanding follow-up and the high complication rate, requiring new treatments at a distance (8, 9). In this situation, mini-invasive techniques have been developed such as video-assisted aortic surgery and total laparoscopy (17-20); however, these require a long learning curve and lengthy operating times, two contributing factors to their limited routine applications. Our attention was thus directed towards minilaparotomy, which has proved to be of excellent practicability.

With upward and downward traction of the operating window, by varying the position of the patient, an operating field is obtained which is restricted but nevertheless sufficient to allow the visualisation of the anatomical structures and the construction of the anastomosis. In a recent study, Matsumoto et al (21) showed that, by varying the position and inclination of the patient as required, in non-obese subjects access can be gained to the outer iliac arteries.

In this case study, the mean duration of the mini-invasive procedures was seen to be slightly lower than that of the conventional ones; this finding is definitely linked to the higher number of aorto-aortic grafts (73%) with the MIS technique, although this also demonstrates that the mini-invasive technique can be carried out in the same length of time as traditional surgery. We found no differences in loss of blood between the two groups, and we observed that these losses were due above all to endoaneurysmorrhaphy and to lumbar artery bleeding. Only in one case carried out with the HALS technique, we had to change to the MIS procedure because of lower mesenteric artery bleeding: this step gave us an excellent surgical field and enabled us to stop the bleeding.

At our institute, in accordance with pre-established anaesthesiological protocols, all patients undergoing aortic endoaneurysmorrhaphy and prosthetic graft are placed in ICU for a period of at least 24 hours to complete the procedure, removing the tubes during the first three hours, cardiorespiratory conditions permitting. Recently, considering the excellent results obtained with mini-invasive surgery and the possibility of monitoring the patients in the operating department in the first 5-6 hours after surgery, with the agreement of the anaesthetists, 3 patients were sent straight to the ordinary ward.

Although there are no precise quantitative data, it seems that mini-incisions and peridural analgesia contribute to better pain control, with less need for of intravenous or oral analgesics administration, particularly in the MIS II group. We observed a slight difference between the MIS I and TAS groups in the time elapsing before the naso-gastric tube removal and the resumption of solids and canalization; this was no doubt due (in part) to the extreme caution we adopted in post-operative management. In the last nine months we have decided to slightly change our protocol, by removing the tube on day I and putting the patient on liquids from day II, obtaining excellent results, with more rapid canalization. We observed no substantial differences among the 3 groups regarding the time elapsing before resumption of active mobility. This can also be accounted for by the habitual caution which characterizes postoperative management in our department.

One difference that should not be overlooked is the duration of post-operative hospital stay, which was a day shorter in the MIS II group.

Minilaparotomy is an interesting alternative to traditional surgery in patients with an aneurysm of the subrenal abdominal aorta or obstructive aorto-iliac arteriopathy. It does not require laparoscopic instrumentation, the learning curve can be overcome with ease and it is easily reproducible.

The HALS technique can provide the same advantages as minilaparotomy, although it has the disadvantage of having higher costs because of the need for laparoscopic instrumentation, as well as its decidedly longer learning curve. The incision of around 6-7 cm does not seem very different from the 8-10 cm minilaparotomy incision, and thus this method can be considered as a training ground for surgeons wishing to attempt total laparoscopy.

Conclusions

The studies reported in literature have shown mini-invasive techniques (minilaparotomy and HALS) to be a valid alternative to traditional surgery. They can help the patient make a more rapid recovery and accelerate his discharge from hospital. They incur fewer costs and are the most easily reproducible procedures (in particular minilaparotomy). An aspect worthy of further study, as some works in literature already testify, is the search for parameters which will enable us to quantify the surgical stress suffered by the patient, and allow us to make a better comparison of the various techniques. Our initial experience, despite of all its limits, herein discussed, deriving from the long learning curve and from the perhaps excessive caution that we adopt in the patient's postoperative management of, has in any case highlighted some encouraging factors, such as the shorter duration of hospital stay and the earlier resumption of solids in some cases, which have prompted us to proceed in this direction.

References

1. DeBakey ME, Cooley DA, Crawford ES, Morris GC Jr. Clinical application of a new flexible knitted Dacron arterial substitute. *Am Surg* 1958; 24: 862-69.
2. Dubost C, Allary M, Oeconomos N. Resection of an aneurysm of the abdominal aorta. *Arch Surg* 1952; 64: 405-8
3. Creech O. Endo-aneurysmorrhaphy. Treatment of aortic aneurysm. *Ann Surg* 1966; 164: 935-46.
4. Thompson JE. Early history of aortic surgery. *J Vasc Surg* 1998; 28 (4): 746-52.
5. Parodi JC, Palmaz JC, Barone HD. Transfemoral intraluminal graft implantation for abdominal aortic aneurysm. *Ann Vasc Surg* 1991; 5 (6): 491-9.
6. Zarins CK, Wolf YG, Lee WA, et al. Will endovascular repair replace open surgery for abdominal aortic aneurysm repair? *Ann Surg* 2000; 232 (4): 501-7.
7. Semm K. Endoscopic appendectomy. *Endoscopy* 1983; 15 (2): 59-64.
8. Engellau L, Albrechtsson U, Hojgard S, Norgren L, Larsson EM. Costs in follow-up of endovascularly repaired abdominal aortic aneurysms. Magnetic resonance imaging with MR angiography versus EUROSTAR protocols. *Int Angiol* 2003; 22 (1): 36-42.
9. Schermerhorn ML, Finlayson SR, Fillinger MF, Buth J, van Marrewijk C,Cronenwett JL. Life expectancy after endovascular versus open abdominal aortic aneurysm repair: results of a decision analysis model on the basis of data from EUROSTAR. *J Vasc Surg* 2002; 36 (6): 1112-20.
10. Enzler MA, van Marrewijk CJ, Buth J, Harris PL. Endovascular therapy of aneurysms of the abdominal aorta: report of 4,291 patients of the Eurostar Register. *Vasa* 2002; 31 (3): 167-72.
11. Cerveira JJ, Halpem VJ et al. Minimal incision abdominal aortic aneurysm repair. *J Vasc Surg* 1999; 30 (6): 977-84
12. Turnipseed WD, Carr SC, et al. Minimal incision aortic surgery. *J Vasc Surg* 2001; 34 (1): 47-53.
13. Kolvenbach R, Da Silva L, et al. Video-assisted aortic surgery. *J Am Coll Surg* 2000; 190 (4): 451-7.
14. Menard MT, Chew DK, Chan RK, et al. Outcome in patients at high risk after open surgical repair of abdominal aortic aneurysm. *J Vasc Surg* 2003; 37 (2): 285-92.
15. Aune S. Risk factors and operative results of patients aged less than 66 years operated on for asymptomatic abdominal aortic aneurysm. *Eur J Vasc Endovasc Surg* 2001; 22 (3): 240-3.
16. Soisalon-Soininen S, Salo JA, Takkunen O, Mattila S. Comparison of long-term survival after repair of ruptured and non-ruptured abdominal aortic aneurysm. *Vasa* 1995; 24 (1): 42-8.
17. Berens ES, Herde JR. Laparoscopic vascular surgery: four case reports. *J Vasc Surg* 1995; 22 (1): 73-9.
18. Chen MH, Murphy EA et al. Laparoscopic-assisted abdominal aortic aneurysm repair. *Surg Endosc* 1995; 9 (8): 905-7.
19. Ahn SS, Hivama DT et al. Laparoscopic aortobifemoral bypass. *J Vasc Surg* 1997; 26 (1): 128-32.
20. Dion YM, Gracia CR. A new technique for laparoscopic aortobifemoral grafting in occlusive aortoiliac disease. *J Vasc Surg* 1997; 26 (4): 685-92
21. Matsumoto M, Hata T, et al. Minimal invasive vascular surgery for repair of infrarenal abdominal aortic aneurysm with iliac involvement. *J Vasc Surg* 2002; 35 (4): 654-60

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