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An Update on the 'Fast-Track' Abdominal Aortic Aneurysm Repair

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An update on the 'fast-track' abdominal aortic aneurysm repair

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Patients who have unfavourable anatomy for endovascular repair of an abdominal aortic aneurysm require open repair. This is particularly the case for juxtarenal aortic aneurysms, or those patients with small or occluded iliac access vessels.

An experience of 'fast-track' abdominal aortic aneurysm repair that was previously reported is updated in the present case. A retroperitoneal approach to the aorta is taken, using a small incision, and is followed by a patient care pathway protocol that demonstrated excellent results and a shortened length of stay. The present update on 56 patients is approximately double the previously reported experience.

Key Words: *Abdominal aortic aneurysm; Juxtarenal; Open repair*

Endovascular repair (ER) of abdominal aortic aneurysms (AAAs) continues to gain market share within the treatment paradigm of AAA disease. Nevertheless, there are a significant number of patients in whom the anatomy of the aneurysm does not permit durable ER. These patients are best managed with open surgical repair (OR) of the aneurysm. In a previous publication (1), the primary author presented his experience with 30 patients who underwent an operation using a limited incision (10 cm to 15 cm in length) for a retroperitoneal approach to the aorta. Standard prosthetic graft endoaneurysmorraphy was performed, and a patient care pathway protocol was used to shorten the length of the hospital stay and improve clinical outcome. Good results were demonstrated in the original report. We report an expansion of our experience to 56 patients, nearly doubling the initial report, along with additional techniques we have developed for management of the challenging juxtarenal aortic aneurysm.

METHODS

The technique for retroperitoneal repair of AAAs has previously been described in detail and will be briefly summarized here (1). The patient is placed with the pelvis flat on the operating table, and the left upper body is angled 45°. This allows for a limited skin incision (10 cm to 15 cm in length) from the lateral border of the left rectus abdominis muscle to the tip of the 11th rib.

After division of the abdominal wall musculature, the peritoneum and its contents are bluntly mobilized medially while leaving the left kidney in its anatomical location. A self-retaining Bookwalter retractor (Codman Inc, USA) was used to expose the aorta from the level of the left renal vein to the iliac bifurcation, including the right common iliac artery. Low-profile Cosgrove clamps (Edwards Lifesciences LLC, USA) were used to allow for atraumatic occlusion of the aorta and iliac arteries, while providing excellent unobtrusive exposure for the surgeon.

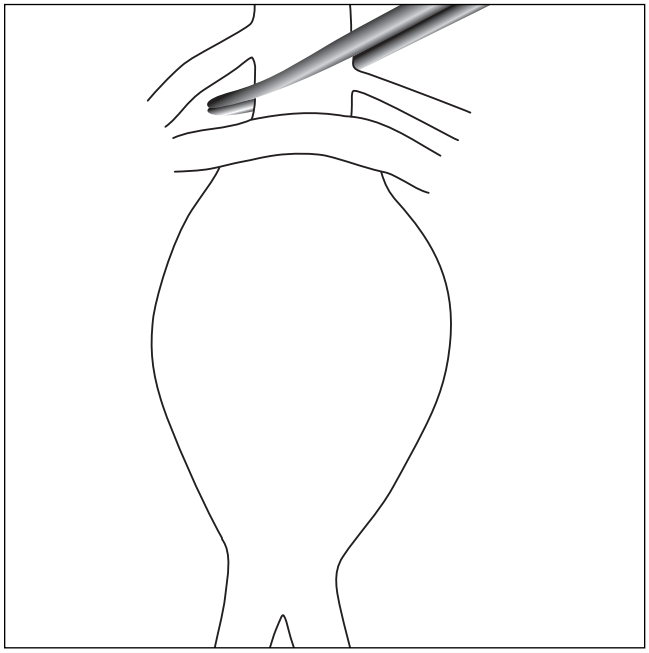

Figure 1) *Aortic clamp placed below one renal artery and above the other*

AAAs with short necks (less than 0.5 cm) or no necks (juxtarenal) have required mobilization of the left renal vein without dividing it, and placement of the proximal aortic clamp above the lower of the two renal arteries (Figure 1). This allows for normal perfusion of the proximal renal artery and creation of the anastomosis in the healthiest section of the aorta, at or just below the renal artery orifice. Back bleeding from the renal artery below the aortic clamp is usually minimal because the renal artery is an end vessel. Rarely will a clamp on the lower renal artery be necessary to prevent back

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TABLE 1
Clinical profile of the first 30 patients undergoing 'fast-track' abdominal aortic aneurysm (AAA) resection

No.	Age, years	Sex	AAA size, cm	ASA class	Blood loss, mL	Graft diameter (mm) and type	ICU LOS	Hospital LOS	Complications	Comments
1.	70	F	5.0	IV	350	18, tube	1	5	Renal failure, dialysis	Solitary kidney with pre-existing renal insufficiency
2.	63	M	5.3	III	400	18, tube	1	3	None	
3.	54	M	5.5	III	500	20 × 10, bifurcated	1	3	None	
4.	67	M	6.6	III	500	20 × 10, bifurcated	1	4	None	
5.	63	M	6.0	III	700	20 × 10, bifurcated	1	4	None	
6.	74	M	5.5	III	500	22, tube	1	3	None	
7.	74	M	8.5	III	500	18, tube	1	3	None	Obese (125 kg), urgent AAA repair
8.	60	M	5.8	III	700	18 × 9, bifurcated	0	3	None	Inflammatory AAA
9.	60	M	6.2	III	500	18, tube	0	4	Ureter injury	Inflammatory AAA
10.	70	M	7.8	IV	500	18 × 9, bifurcated	0	7	Transient renal insufficiency	Symptomatic AAA, urgent repair
11.	73	M	5.2	III	500	18, tube	0	3	None	
12.	77	M	6.2	III	450	16 × 8, bifurcated	1	3	None	
13.	67	M	5.5	III	400	18, tube	0	3	None	Left adrenalectomy for adenoma
14.	60	M	6.0	III	500	20 × 10, bifurcated	0	3	None	Obese (120 kg)
15.	68	M	5.8	III	400	18 × 9, bifurcated	1	3	None	
16.	50	M	5.5	II	400	18 × 9, bifurcated	0	3	None	
17.	62	M	5.5	III	350	18, tube	1	4	None	Symptomatic AAA, urgent repair
18.	61	M	6.5	III	5400	20 × 10, bifurcated	1	1	Expired, splenic injury	Not EVAR candidate
19.	70	M	5.5	IV	400	20, tube	1	4	None	Juxtarenal AAA
20.	63	M	7.0	III	800	22, tube	1	3	None	Juxtarenal AAA
21.	73	M	5.5	III	1100	18 × 9, bifurcated	1	3	None	Occluded iliac artery
22.	72	M	6.9	III	500	20, tube	1	3	None	
23.	81	F	5.0	III	500	18, tube	1	4	None	Symptomatic AAA
24.	65	M	6.1	III	1300	20, tube	1	4	None	Previous renal transplant
25.	71	M	7.5	III	500	18, tube	1	3	None	Juxtarenal AAA
26.	88	F	6.5	III	1300	20, tube	1	4	None	Inadequate neck for EVAR
27.	65	M	7.5	III	700	22, tube	0	3	None	Juxtarenal AAA
28.	67	F	5.5	III	350	16, tube	1	3	None	Inadequate neck for EVAR
29.	67	F	5.5	III	1200	16 × 8, bifurcated	1	3	None	Small iliac artery
30.	69	M	6.5	III	500	18, tube	1	4	None	Inadequate neck for EVAR

Data from reference 1. ASA American Society of Anesthesiology; EVAR Endovascular aneurysm repair; F Female; ICU Intensive care unit; LOS Length of stay, days; M Male; No. Patient identification number

bleeding. On completion of the proximal anastomosis, the clamp is moved onto the graft, allowing perfusion of both renal arteries.

A standard postoperative protocol is followed; it begins with a minimum of 4 h recovery in the postanesthesia care unit before determining whether monitoring in the intensive care unit (ICU) is necessary. Most patients who require ICU observation stay overnight and transfer to the surgical floor on postoperative day 1. Intravenous metacloperamide 10 mg is administered every 8 h in the immediate postoperative period for bowel stimulation. Clear liquids are started on the first postoperative day and advanced, as tolerated, to soft foods by postoperative day 3.

A bisacodyl suppository is administered on postoperative day 2 or 3, if required, for stimulation of a bowel movement. Epidural anesthesia is used in the immediate postoperative period, with transition to oral analgesics and removal of the epidural and urinary catheters on postoperative day 2 or 3. Most patients are discharged on postoperative day 3 or 4.

RESULTS

The initial experience with 30 consecutive patients (Table 1) has now been nearly doubled to total 56 (Table 2). The group is comprised of 20% women (n=11) and 80% men (n=45) with infrarenal AAA measuring greater than 5.0 cm (range 5.0 cm to 8.5 cm; median 5.7 cm) that were repaired electively (n=49) or urgently (n=7). All AAA patients since January 2001 were evaluated for either OR or ER. Patients who were not candidates for ER because of unfavourable AAA anatomy underwent OR; patients who were good candidates for both were given an informed choice. Patients determined to be poor operative candidates at high risk of perioperative morbidity and mortality underwent ER. The most common reason for failure of ER candidacy is lack of an adequate 'neck' for proximal landing of the stent graft. The breakdown of patients, according to American Society of Anesthesiology (ASA) classifications, was: ASA II, 4% (n=2); ASA III, 75% (n=42); and ASA IV, 21% (n=12).

Most patients (n=48) stayed at least overnight in the ICU, although this is not the rule, and patients have been transferred directly to the surgical ward after a period of observation of at least 4 h in the postanesthesia care unit. The average length of stay for patients transferred to the ICU postoperatively was one day, with transfer to the surgical ward on postoperative day 1.

Removing the outliers at both ends (patients 18 and 54; Tables 1 and 2), the average length of stay in the hospital for

TABLE 2
Clinical profile of patients who underwent 'fast-track' abdominal aortic aneurysm (AAA) resection after the initial report

No.	Age, years	Sex	AAA size, cm	ASA class	Blood loss, mL	Graft diameter (mm) and type	ICU LOS	Hospital LOS	Complications	Comments
31.	71	M	5.5	IV	500	18 × 9, bifurcated	1	4	None	Juxtarenal AAA
32.	70	M	6.0	III	1200	18 × 9, bifurcated	1	6	None	Juxtarenal AAA
33.	55	F	5.3	IV	500	16, tube	2	3	None	Inadequate neck for EVAR
34.	76	M	6.0	IV	200	16 × 8, bifurcated	1	4	None	Inadequate neck for EVAR
35.	62	F	5.5	III	500	18, tube	1	3	Incisional hernia	Juxtarenal AAA
36.	82	M	6.0	III	1200	18 × 9, bifurcated	1	4	None	Juxtarenal AAA
37.	78	M	7.0	III	1500	20 × 10, bifurcated	1	5	None	Juxtarenal AAA
38.	61	M	6.0	III	700	16, tube	1	3	None	Inadequate neck for EVAR
39.	75	M	6.4	III	500	18, tube	3	9	Cardiac dysrhythmia	Symptomatic juxtarenal AAA, urgent repair
40.	79	M	6.5	IV	2000	24, tube	1	4	Ischemic colitis	Juxtarenal AAA
41.	73	M	5.0	III	3000	16, tube	1	5	None	Juxtarenal AAA
42.	67	F	6.0	IV	700	24, tube	1	4	None	Symptomatic juxtarenal AAA, urgent repair
43.	70	M	5.5	III	1000	18, tube	1	4	None	Inadequate neck for EVAR
44.	78	F	6.0	IV	1000	16 × 8, bifurcated	1	4	None	Inadequate neck for EVAR
45.	63	M	7.0	III	800	22, tube	1	3	None	Juxtarenal AAA
46.	79	M	6.0	III	200	16 × 8, bifurcated	1	4	None	Juxtarenal AAA
47.	77	M	6.0	III	1200	16 × 8, bifurcated	1	3	None	Juxtarenal AAA
48.	64	F	5.5	III	200	14, tube	2	4	None	Juxtarenal AAA
49.	83	M	5.5	IV	700	16 × 8, bifurcated	1	4	None	EVAR attempt unsuccessful due to iliac occlusive disease
50.	63	M	6.5	III	850	16 × 8, bifurcated	2	4	None	Symptomatic juxtarenal AAA, urgent repair
51.	64	M	5.1	III	700	18 × 9, bifurcated	1	4	None	Rapidly expanding, inadequate neck for EVAR
52.	63	M	5.8	III	200	16 × 8, bifurcated	1	3	None	EVAR candidate, patient choice
53.	69	M	6.0	III	450	16 × 8, bifurcated	3	5	Atrial fibrillation	Juxtarenal AAA
54.	80	M	5.6	IV	700	18, tube	7	14	Pneumonia, renal failure, dialysis	Juxtarenal AAA
55.	67	M	5.3	IV	600	20, tube	1	3	None	Symptomatic juxtarenal AAA, urgent repair
56.	76	F	6.0	II	700	16, tube	1	4	None	Inadequate neck for EVAR

ASA American Society of Anesthesiology; EVAR Endovascular aneurysm repair; F Female; ICU Intensive care unit; LOS Length of stay, days; M Male; No. Patient identification number

the series of patients was 3.8 days, with a range of three to nine days.

Complications occurred in 16% of patients (n=9); these included cardiac dysrhythmias (n=2), transient renal insufficiency (n=1), renal failure requiring hemodialysis (n=2), ureter injury recognized intraoperatively and repaired (n=1), self-limited ischemic colitis (n=1), incisional hernia (n=1) and splenic injury (n=1). The mortality rate in the present series was 1.8% (n=1). This patient sustained a splenic injury from operative retraction in the region of the left upper quadrant with delayed diagnosis and hemorrhagic shock.

DISCUSSION

There has been a flurry of clinical research reported since the emergence of ER of AAAs in 1991 (2-15). It has been demonstrated that the short-term morbidity and mortality of ER is significantly better than OR (4,7,10,15). The Endovascular Aneurysm Repair (EVAR) Trial 1 (7) demonstrated a persistent 3% reduction in aneurysm-related deaths after four years in patients with ER versus OR, but with a significantly higher incidence of postoperative complications. This included the need for secondary intervention in those who underwent ER (41%) versus OR (9%) (7,10). The long-term durability of AAA OR has been well established, with several reports demonstrating late graft-related complications of 2.5% to 6.8% over a follow-up period of as many as 36 years (10). The need for secondary intervention is not benign; it increases the morbidity and mortality risk for the patient. It also increases the hospital costs for treatment of the AAA above the already high costs of ER compared with OR (8,11,14).

The trend in the long-term durability of AAA ER using current technology indicates a significant number of postoperative complications. Therefore, it also indicates a requirement for regular surveillance and a significantly higher rate of secondary interventions over the AAA OR (10). This has led many vascular surgeons to reserve its use only for those patients who are poor operative candidates. However, this patient population is shrinking due to improvements in anesthesia and intraoperative monitoring, preoperative cardiac and pulmonary evaluation and optimization, and postoperative care,

TABLE 3
Updated comparison of 'fast-track' and mini-laparotomy techniques of abdominal aortic aneurysm repair

	Turnipseed, 2001 (19)	Cerveira et al, 1999 (17)	Current series
Number of patients	40	11	56
Intraoperative outcomes			
Average OR time, min	185	131	175
Average blood transfusions, units	1.1±1.5	1.1±1.4	0.8±1.4
Postoperative outcomes			
Average ICU stay, days	1.0	1.9	1.1
Time to diet, days	3.0	3.7	3.2
Average hospital stay, days	4.9	5.2	3.9
Morbidity rate, %	13	18	13
30-day mortality rate, %	0	0	1.8

ICU Intensive care unit; OR Open surgical repair

especially in the field of critical care medicine. The desire for the proven long-term durability of AAA OR and a morbidity rate comparable with AAA ER has led to newer, less invasive techniques in OR, such as use of the mini-laparotomy and laparoscopic assistance (16-21). Case comparisons between OR and ER at the same institution, by the same surgeons, during the same time period have demonstrated similar objective results and a significant OR cost advantage (2,7,21).

We have previously reported our initial experience using a limited-incision retroperitoneal approach to AAA OR, and the use of low-profile clamps and retractors to improve visualization while limiting interference for the surgeon (1,2). In addition, we have developed a 'fast-track' postoperative care protocol in an effort to maximize return of bowel function and mobility (1). This includes physical therapy initiation on postoperative day 1, with discharge typically on postoperative day 3, either to home or to an inpatient rehabilitation facility if determined necessary. We have nearly doubled this initial report to now include 56 consecutive retroperitoneal AAA repairs using our 'fast-track' protocol.

Consistent with our initial findings, patient morbidity and mortality in our updated results were similar to the morbidity and mortality of the mini-laparotomy approach.

However, the advantage of the retroperitoneal approach is the avoidance of bowel manipulation and ileus development. This allows us to start oral intake almost immediately, including oral medications for blood pressure control and cardioprotection. In contrast to the mini-laparotomy series (19), we use epidural analgesia, which we believe allows quicker postoperative mobility due to improved pain control. At the appropriate dose, epidural pain control is excellent and allows continued use of the lower extremities, enabling the patient to get out of bed on postoperative day 1. The epidural and Foley catheters are typically removed on postoperative day 2, with analgesia provided orally with intravenous supplementation.

Our updated results continue to support our original claim that our 'fast-track' retroperitoneal AAA repair and patient-care pathway is similar to minimally invasive AAA repair (eg, mini-laparotomy or laparoscopic-assisted repair) in regard to objective measurements, such as operative times, transfusion requirements, hospital stay, and overall morbidity and mortality (Table 3). The advantages of our technique are the limited bowel manipulation from avoiding a transperitoneal approach, and the technique's ability to be performed without advanced laparoscopic skills, necessary equipment and the associated significant learning curve required to perform the operation safely and successfully.

Using retroperitoneal OR, we have been able to approach difficult juxtarenal AAA with a unique approach that enables perfusion to at least one renal artery, avoiding significant postoperative renal dysfunction. We place a clamp above the lower of the two renal arteries while the proximal aortic anastomosis is performed. This allows clamping and creation of an anastomosis at the healthiest section of the aorta, at or just below the renal orifice, avoiding the risk of renal ischemia and the potential for significant renal injury. It also ensures that the anastomosis is performed on a healthy portion of aorta, avoiding any fragile, diseased portion of the aorta. On completion of the proximal anastomosis, the clamp is moved onto the graft, allowing for perfusion of both renal arteries to resume. Using this technique, we had no incidents of prolonged renal insufficiency or renal failure.

CONCLUSION

Our technique for AAA repair uses a limited retroperitoneal incision and a 'fast-track' protocol for postoperative care that focuses on pain management using epidural analgesia, early ambulation with immediate physical therapy consultation, and early diet resumption. Our updated experience continues to support our claim that AAA OR has similar results to AAA ER and other minimally invasive AAA OR techniques, such as mini-laparotomy and laparoscopy-assisted repair, with several advantages. These advantages are the proven long-term durability of OR; the fact that close lifelong surveillance is not required as with ER, a significant cost savings to the health care system, and a cost and time savings for patients; advanced endovascular skills and the associated equipment are not necessary; advanced laparoscopic skills are not needed, as with laparoscopic-assisted approaches; and the reintervention rate and related morbidity is significantly lower than with ER using current available technology.

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