Feasibility of endovascular repair of abdominal aortic aneurysms with local anesthesia with intravenous sedation

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Purpose: **Local anesthesia has been shown to reduce cardiopulmonary mortality and morbidity rates in patients who undergo selected peripheral vascular procedures. The efforts to treat abdominal aortic aneurysms (AAAs) with endovascular techniques have largely been driven by the desire to reduce the mortality and morbidity rates as compared with those associated with open aneurysm repair. Early results have indicated a modest degree of success in this goal. The purpose of this study was to investigate the feasibility of endovascular repair of AAAs with local anesthesia.**

Methods: **During a 14-month period, 47 patients underwent endovascular repair of infrarenal AAAs with local anesthesia that was supplemented with intravenous sedation. Anesthetic monitoring was selective on the basis of comorbidities. The patient ages ranged from 48 to 93 years (average age, 74.4 ± 9.8 years). Of the 47 patients, 55% had significant coronary artery disease, 30% had significant chronic obstructive pulmonary disease, and 13% had diabetes. The average anesthesia grade was 3.1, with 30% of the patients having an average anesthesia grade of 4. The mean aortic aneurysm diameter was 5.77 cm (range, 4.5 to 12.0 cm). All the implanted grafts were bifurcated in design.**

Results: **Endovascular repair of the infrarenal AAA was successful for all 47 patients. One patient required the conversion to general anesthesia to facilitate the repair of an injured external iliac artery via a retroperitoneal approach. The operative mortality rate was 0. No patient had a myocardial infarction or had other cardiopulmonary complications develop in the perioperative period. The average operative time was 170 minutes, and the average blood loss was 623 mL (range, 100 to 2500 mL). The fluid requirements averaged 2491 mL. Of the 47 patients, 46 (98%) tolerated oral intake and were ambulatory within 24 hours of graft implantation. The patients were discharged from the hospital an average of 2.13 days after the procedure, with 87% of the patients discharged less than 48 hours after the graft implantation. Furthermore, at least 30% of the patients could have been discharged on the first postoperative day except for study protocol requirements for computed tomographic scanning at 48 hours.**

Conclusion: **This is the first reported series that describes the use of local anesthesia for the endovascular repair of infrarenal AAAs. Our preliminary results indicate that the endovascular treatment of AAAs with local anesthesia is feasible and can be performed safely in a patient population with significant comorbidities. The significant potential advantages include decreased cardiopulmonary morbidity rates, shorter hospital stays, and lower hospital costs. A definitive evaluation of the benefits of local anesthesia will necessitate a direct comparison with other anesthetic techniques. (J Vasc Surg 1999;29:793-8.)**

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The first successful aortic reconstruction for an abdominal aortic aneurysm was performed by Dr Charles Dubost on March 29, 1951, in Paris, France.[1] Since this landmark procedure, a variety of measures to reduce the associated morbidity and mortality rates have been extensively investigated. Through improvements in preoperative evaluations, anesthetic techniques and monitoring, surgical materials and methods, and postoperative care, the mortality rate of elective abdominal aortic aneurysm repair has been

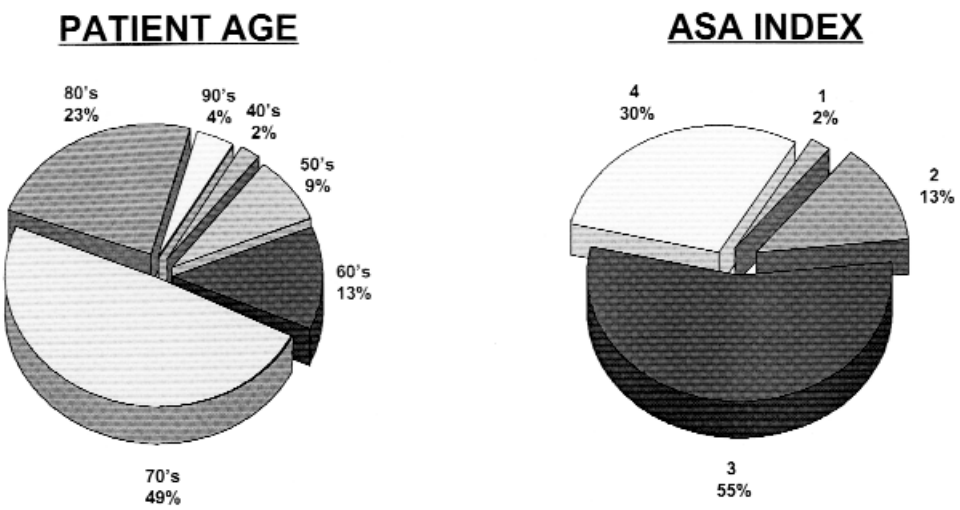

Fig 1. Patient demographics.

reduced to approximately 4%.[2] However, the associated cardiopulmonary morbidity rate remains significant and is cited at approximately 23%.[3]

Despite the proven efficacy of this procedure, the efforts to further reduce the associated morbidity and mortality rates have led to the development of less invasive endovascular techniques for the exclusion of abdominal aortic aneurysms. An added advantage of this transfemoral repair is the expanded anesthetic options, specifically, local anesthesia with intravenous sedation. Local anesthesia is believed to offer a reduction in the anesthetic-related cardiopulmonary morbidity rate and is often the anesthesia of choice for patients at high risk when applicable. This report attempts to establish the feasibility of the endovascular repair of abdominal aortic aneurysms with local anesthesia with intravenous sedation.

METHODS

Currently, in the United States, all endografts procedures for the repair of abdominal aortic aneurysms are performed with investigational protocols. The procedures reported herein were all performed as part of a United States Food and Drug Administration–approved phase II clinical trial. During a recent 14-month interval, 47 of 48 consecutive patients underwent attempted endovascular repair of nonruptured abdominal aortic aneurysms with local anesthesia with intravenous sedation using a bifurcated, modular, and self-expanding aortic endograft (AneuRx Medtronic, Sunnyvale, Calif). The one exception was the case of a 91-year-old man with a history of severe esophageal stricture with a feeding tube in whom general endotracheal anesthesia was chosen because of concern about secretion management. The local anesthesia consisted of 10 to 20 mLs of 1% lidocaine injected at each groin cutdown. Additional local anesthesia was administered to perform retroperitoneal exposure in two patients who required the repair of injured iliac arteries. Another patient with this problem was the only patient in this series who underwent conversion to general anesthesia. Intravenous sedation usually involved a titration of propofol and midazolam, with some variation among the different anesthesiologists. The amount of sedative used and the depth of sedation maintained were largely dependent on the length of the case. Although only a quarter of the patients were awake enough to be cooperative during the entire case, most were easily aroused within minutes of stopping the titrated sedative drips. Most of the patients were able to control their own airways, with only three patients requiring an oral airway or other airway protectant. Furthermore, intravenous sedation was used to maintain patient comfort rather than to provide direct analgesia. Only three patients had any formal preoperative cardiac evaluation because this was indicated only for those with unstable angina or new cardiac abnormalities. Operative monitoring included continuous cardiac electrocardiography, pulse oximetry, radial artery pressure monitoring, and central venous access without pulmonary artery catheterization.

All patients but one were cared for after surgery in the intermediate care unit. The only patient taken to the intensive care unit was monitored for an episode of hypotension in the recovery room that responded to a fluid bolus and proved uneventful.

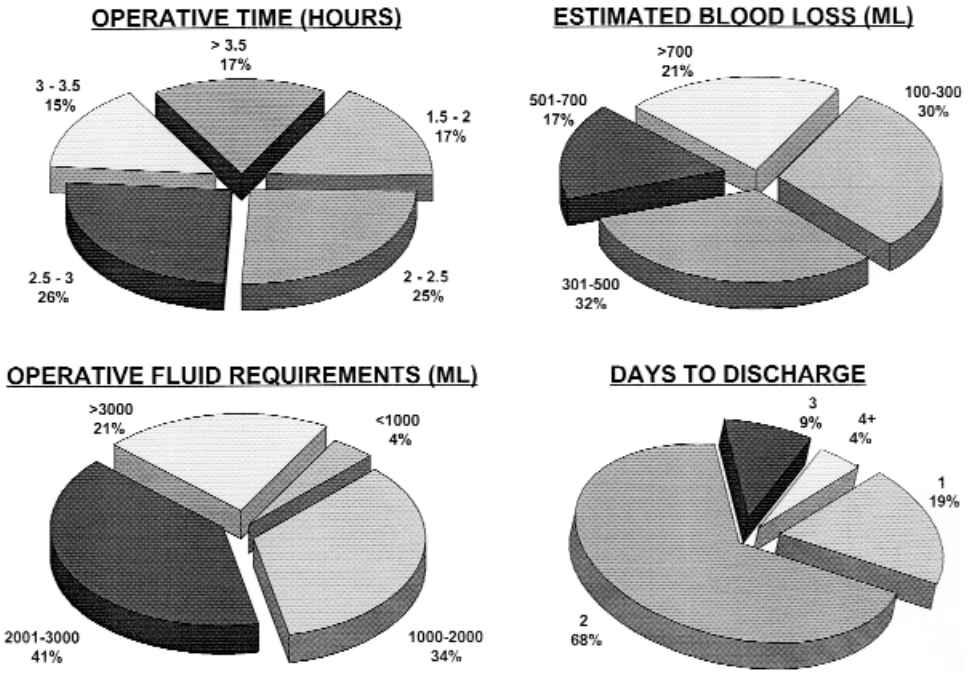

Fig 2. Breakdown of results.

The procedures were performed in a catheterization laboratory with full surgical capabilities.

The average age of the patients in this series was 74.4 years (range, 48 to 93 years; Fig 1). The mean maximal aneurysm diameter was 5.77 cm. Representative comorbidities included diabetes (6 of 47 patients; 13%), significant pulmonary disease (14 of 47 patients; 30%), and coronary artery disease (26 of 47 patients; 55%). Each of these comorbidities had a significant effect on the patient and thus was disabling. The pulmonary factors included asthma or emphysema, and the cardiac factors included active angina or previously treated coronary or valvular heart disease. An American Society of Anesthesiology (ASA) classification of 3 indicates a severe systemic disease that limits activity, and a 4 indicates incapacitating systemic disease that threatens life.[4] This group had an average ASA grade of 3.13, with 14 of 47 patients (30%) classified with a 4. All the patients who were classified with ASA 4 were placed in this category as a result of severe cardiopulmonary disability and either required home oxygen for pulmonary disease or had cardiac disease that was considered life threatening.

RESULTS

The successful placement of an endoluminal graft was performed in all 47 patients with no conversions to standard surgical repair. One patient underwent conversion to general endotracheal anesthesia midway through the case to facilitate the repair of a disrupted external iliac artery caused by excessive traction. Two other patients also required retroperitoneal exposure to repair injured external iliac arteries, but these procedures were performed with local anesthesia. Therefore, local anesthesia with intravenous sedation was the only anesthetic used in 46 of 47 patients (98%). The procedural data are depicted in Fig 2. The average operative time was 170 minutes, with a range of 90 to 431 minutes. The estimated blood loss averaged 623 mL (range, 150 to 2500 mL), and the fluid requirements were 2491 mL (range, 800 to 6800 mL). Three patients required intraoperative transfusions, and an additional six patients underwent postoperative transfusions. There was no mortality and no cardiopulmonary morbidity in the entire group of patients in the 30-day perioperative period. All patients but one were ambulatory independently within 24 hours of graft implantation. The exception had a history of previous cerebral vascular accident with hemiparesis. All the patients were tolerating oral intake within 12 hours of the procedure, although one patient did have an adynamic ileus develop that was thought to be related to the retroperitoneal exposure. The average time to discharge was 2.13 days. Of the patients, 19% (9 of 47 patients) were discharged on postoper-

Table I. Endovascular repair of abdominal aortic aneurysms: comparison with previous studies

	No. of patients	*Technical success rate*	*Open conversion*	*Perioperative mortality rate*	*Cardiopulmonary morbidity rate*	*Endoleaks*	*Rupture*	*Vascular trauma*	*Renal insufficiency*	*Mean follow-up period (months)*
Henretta (1998)	47	100%	0	0	0	6%	0	15%	0	8
Stetler[12] (1997)	201	89%	2.0%	3.5%	0	18%	0	17%	2.5%	11
Blum[13] (1997)	154	87%	1.9%	0.6%	0	11%	0	5.1%	1.3%	13
Miahle[14] (1997)	79	83%	0	4.8%	4.8%	24%	0	15%	2.5%	5.7
May[15] (1998)	108	88%	12.0%	5.6%	2.7%	13%	0	11%	8.3%	29

ative day 1, 87% (41 of 47 patients) were discharged within 48 hours, and at least 30% could have been discharged on the first postoperative day except for study protocol requirements for computed tomographic scanning at 48 hours. Three patients (6.4%) had noncardiopulmonary morbidity in the 30-day perioperative period. A prolonged ileus, as described previously, developed in one patient. A brachial hematoma with mild postevacuation neuralgia and a right lower extremity embolism that resolved with embolectomy developed in another patient. Both of these complications were diagnosed and treated approximately 3 hours after the aneurysm repair. The final patient had an asymptomatic occlusion of a left common femoral artery repair as the result of a flap from posterior wall plaque that was treated with a local endarterectomy and patch angioplasty 30 hours after the aneurysm repair. A total of seven patients required the operative repair of vascular trauma that was related to the treatment: the previously mentioned two patients, three patients who required iliofemoral bypass grafting to repair traumatized external iliac arteries, and two patients who required interposition reconstruction of transected common femoral arteries.

The successful exclusion of the aneurysm was confirmed within 1 month after surgery in 42 of 47 patients (89%). Four patients continued to have an endoleak at 3 months, and two of these endoleaks were successfully resolved with further endovascular procedures. The remaining two patients underwent evaluation with angiography and were found to have only perigraft flow with no break in the integrity of the graft. It was believed that the flow between two lumbar arteries or between a lumbar and a patent inferior mesenteric artery were low pressure situations, and both patients have been followed with serial computed tomographic scans with evidence of some aneurysm resolution. Although these patients are believed to be at a low risk for aneurysm rupture, they are followed closely with serial computed tomographic scanning and, if the aneurysm size increases, would be considered at high risk and would undergo aggressive treatment. The last patient is between the 1-month and 3-month evaluations and, if the leak persists on the next scan, will undergo further diagnostic and therapeutic interventions.

DISCUSSION

The debate as to whether regional anesthesia provides an advantage over general anesthesia remains a controversy in vascular surgery. Most reports conclude that there is no significant difference in terms of associated morbidity and mortality rates.[5-7] Certain studies have suggested a possible improvement in early graft function with spinal anesthesia. However, none of these reports on regional anesthesia have focused on the potential benefits of specifically local anesthesia. To date, there are no prospective studies that compare local anesthesia with other techniques in regards to vascular procedures. The one exception is during carotid endarterectomy in which the advantage of having an awake patient is primarily to monitor neurologic function.[8-10] In general, it is believed that local anesthesia minimizes cardiopulmonary morbidity rates and, when applicable, is the anesthesia of choice for patients at high risk with severe comorbidities. Furthermore, when local anesthesia was compared with other anesthetics, there was a reduction in anesthesia and the recovery room time and cost.[10,11]

In this series of 47 patients, there was no cardiopulmonary morbidity and no mortalities, despite a population with significant coexisting conditions. The decreased physiologic stress associated with endovascular grafting is largely responsible for this improved outcome. However, the results also testify to the safety of performing endovascular repair of abdominal aortic aneurysms with local anesthesia. A comparison with other reports reveals that our current study has equivalent, if not improved, results (Table I). This may be explained by graft design, differences in technique and patient management, and relatively small

sampling. It does, however, indicate the feasibility of effectively deploying an endograft with local anesthesia. No surgical conversions were performed, and only one patient did not have the procedure completed with local anesthesia. This patient required the repair of a transected external iliac artery, and general anesthesia was performed to maximize patient control in case of significant hemorrhage, which was a concern that did not materialize.

The passage of relatively large, stiff deployment catheters through the iliac arteries was well-tolerated with intravenous sedation. Perhaps the only drawback of this approach was the inability to control respiratory motion during radiographic filming. Although some investigators may advocate general anesthesia to minimize patient movement and to control breathing artifact that would interfere with graft placement with landmarks or road mapping, this concern is negated and precise infrarenal graft placement was assured by real time visualization of the renal arteries during graft delivery. This was achieved by performing angiography with a perirenal catheter passed from the contralateral groin (Fig 3).

The continued endoleak rate beyond 1 month in this group is 6.4%, with two of these three patients known to have successful graft integrity but perigraft flow caused by persistent lumbar or inferior mesenteric artery patency. This situation is presumed to be less threatening than a graft-related endoleak. Although the leak rate is most directly an evaluation of graft design and technical placement, it does once again attest to the feasibility of abdominal aortic aneurysm endografting with local anesthesia.

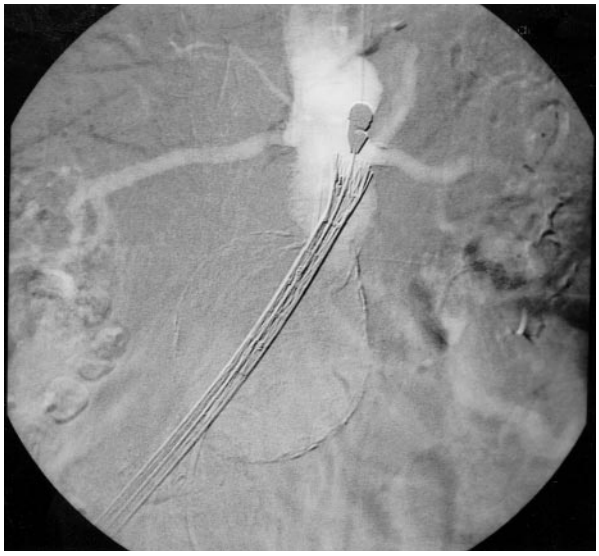

Fig 3. Localization of renal artery during grafting.

CONCLUSION

Forty-six of forty-seven patients (98%) who underwent the attempted endovascular repair of abdominal aortic aneurysms with local anesthesia with intravenous sedation underwent successful endografting without a change in their anesthetic management. There were no conversions to conventional surgical repair. The one patient who underwent conversion to general anesthesia underwent this change to facilitate access to an injured iliac artery. Concerns of patient tolerance for this repair with local anesthesia were perhaps unfounded because two other patients also underwent a similar repair without requiring general anesthesia. Despite a large percentage of patients with significant comorbidities, there was no associated cardiopulmonary morbidity or mortality in our series. The airway and hemodynamic monitoring and management needs were all easily met with local anesthesia with intravenous sedation. The results of this report show the feasibility of endovascular repair of abdominal aortic aneurysms with local anesthesia. Further attempts to elucidate a significant advantage of this anesthetic approach will necessitate a randomized prospective evaluation.

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