Endovascular repair of aortic abdominal aneurysm (AAA) is superior to open repair and the current trend towards its increased use is justified.

PRO:

Balachundhar Subramaniam, MD
Beth Israel Deaconess Medical Center
Harvard Medical School
Boston, MA.

Abdominal aortic aneurysm (AAA) carries a significant risk of rupture when it grows beyond 5 cm. Ruptured aneurysms have > 50% mortality rate. Hence prophylactic surgery at this stage prevents such a catastrophe. AAA can be repaired either by open or endovascular aneurysm repair (EVAR). Open repairs carry a 5 to 10% operative mortality and a major complications rate of 15 to 30%. The morbidity and mortality increase substantially in elderly patients and in those with pulmonary, cardiac, or renal co-morbidities. Many elderly or frail patients never quite return to baseline function. Traditional open repair can lead to prolonged intensive care stays, extended hospitalizations, and other excessive resource use, which can become a strain fiscally to many hospitals in the current cost-conscious era. EVAR was pioneered by Parodi and Volodos in the early 1990s and is a less invasive alternative to conventional open repair (1, 2). EVAR involves small incisions in the groin to access femoral arteries and to place endograft under fluoroscopic guidance to exclude aneurysmal sac.

EVAR is safe and can be successfully performed in patients with suitable anatomy (3-6). The advantages of this technique are low perioperative mortality, initial 98 to 99% success, stability or decrease in size of AAA, and infrequent complications such as 1% early conversion rate, conversion to open repair and AAA rupture. EVAR decreases perioperative morbidity relative to standard open repair and decreases intensive care unit and total hospital stay (7) with increased quality of life in the perioperative period and a more rapid recovery time (8). Anatomic selection and warding off technical difficulties should be the key while doing EVAR.

With these significant advantages EVAR was primarily started as a treatment option and continues to be an attractive and often the only option for patients with multiple organ dysfunctions and in very elderly patients (9). Ruptured AAA carries a 50%-70% mortality following conventional open repairs. EVAR is a viable option for ruptured AAAs (40%). A significant reduction in mortality and complication rates was seen for patients receiving EVAR that correlates with the volume of procedures carried at by a hospital (10). There is a decreased rate of pulmonary, renal and bleeding complications following EVAR (11). As a result, there is a trend of increasing utilization of EVAR even for ruptured AAAs and a corresponding decline in open procedures.

When we look at the adverse events, EVAR carries a 1.4% operative mortality rate and a significant decrease in perioperative morbidity. There is a 2-10% incidence of acute renal failure (ARF) following open repair, which prolongs hospital stay. ARF requiring hemodialysis (0.5-2%) caries an in-hospital morality rate of 25-66%. When adjusted for covariates, the association between EVAR and the risk of ARF remained significantly low compared to open AAA (OR 0.42; 95% CI 0.33-0.53) (12).

Abnormal but low postoperative troponin elevation is associated with increased mortality and may lead to delayed postoperative myocardial ischemia (13). In a prospective study, Abraham et al. showed that there is a previously underestimated incidence of subclinical myocardial damage associated with surgery for infrarenal AAA, which is lower after endovascular than open repair (14). Pearson et al. found that an attenuated glucocorticoid surge characterizes the reduced stress response experienced by patients undergoing EVAR compared to open repair and suggested that a reduction in the occurrence of Systemic Inflammatory Response Syndrome is a feature of a more favorable postoperative course after an endovascular approach (15). These factors strongly support the increasing use of EVAR in patients presenting with suitable anatomy.

In the prospective randomized controlled trials, EVAR has been shown to have a significantly better perioperative outcome. There is a lower incidence of intraoperative blood loss, lower pulmonary complications, postoperative mechanical ventilation all reflecting the nature of surgery (DREAM trial, EVAR-1) (16,17). The risk of in-hospital mortality is 5.8% in the open-repair group, compared to 1.9% in the endovascular repair group, resulting in a risk ratio of 3.1 (95% CI 1.7-6.2). Before the EVAR era, operative mortality rates of 8% were reported in the population based series. Current mortality rates of open repairs are approximately 4%. This is probably because EVAR is probably the only option in high-risk patients. A patient's eligibility for EVAR is dependent on the state of device technology. The introduction of fenestrated and branched endografts is expected to increase the proportion of patients with AAA who can be treated by EVAR in the near future. With improvement in surgical skills and the number of such procedures performed, success is bound to improve. This may ultimately decrease the graft failure rates. As we go along matching the technology growth with patient selection, the failure rates will decrease.

Because of the significant risk reduction, perioperative anesthetic care of such patients is less risky than open surgeries. Although all the patients who undergo EVAR are prepared as though they are having open procedures in many centers, with more experience and patient selection, these procedures can probably be safely done under local or regional anesthesia with less invasive monitoring (18) and significantly reduced preoperative work-ups. They will probably carry less perioperative morbidity and mortality and decreased utilization of operating room and recovery room times.

In younger patients with no other organ dysfunction, the debate sets in as to whether to offer EVAR or open surgery as procedure of choice. Open AAA has shown to be highly successful over the last fifty years with less than 0.5% graft failure rates. Until such long-term data are available in EVAR, it will remain a challenge to convince many. However, in such patient population with a suitable anatomy and surgical expertise, increasing use of EVAR is probably justified based on its better perioperative outcome data. For smaller aneurysms either therapy is not in a stage to be beneficial as the risk of rupture is less than 1% per year, although it would be a great temptation to do EVAR. This is a potential area of interest and may very well prove to be true indication if the long-term outcomes of EVAR are proven.

EVAR carries an important postoperative long-term follow-up surveillance costs. EVAR is a new art which mandates such follow-ups. The endovascular stents are undergoing constant improvement and so are the surgeons and interventionalists. Follow-up costs and the reoperation rates for leaks are primary factors pointed against routine EVAR for all aneurysms. These are likely to decrease as we are bound to identify

Continued on pagenext page

CON:

Miodrag Filipovic, MD
University Hospital Basel
Basel, Switzerland

Abdominal aortic aneurysm (AAA) is much more common in men than in women and its incidence increases rapidly with age.1,2 The prevalence of AAA is around 5% in men over the age of 65 years.1,3 In contrast to other cardiovascular diseases where rates of hospital admission and deaths have fallen over the last decades,4 the rates for AAA have risen.2

Patients with AAA are at risk for vascular rupture and subsequent death. Standard treatment for AAA with a diameter > 5.5 cm is open surgical repair with the aim to prevent rupture.5,6 Despite advances in the perioperative care of patients with AAA, the complication rate remains high. The perioperative mortality after elective open repair is 3 to 5% and perioperative mortality after emergent open repair of a ruptured AAA is 40 to 50%.2 Endovascular aneurysm repair (EVAR) was introduced into clinical practice in the 1990s.7 The AAA is excluded from the circulation by placing an endograft, using a transfemoral or transiliac route. Compared with open repair, EVAR causes less surgical trauma and does not require cross clamping of the aorta. Accordingly, EVAR is expected to diminish perioperative morbidity and mortality by causing less hemodynamic instability8 and by minimizing the stress response and physiologic disruption. EVAR can be performed under general, regional (epidural or spinal), and even local anesthesia.9 EVAR attenuates respiratory dysfunction associated with open AAA repair and reduces perioperative analgesia requirements.10 The suitability of patients with AAA for EVAR depends on a detailed anatomic evaluation that takes diameter, angulation, and length of the proximal aorta into account.11,12 However, the proportion of patients actually regarded as suitable for EVAR depends on the experience of the surgical team. This proportion was 54% in the EVAR-1 trial.13

Short-term outcome after EVAR

As expected from the reduced physiologic disruption, EVAR had a better short-term outcome compared with open repair. A retrospective analysis of the US National Inpatient Database showed a lower in-hospital mortality from EVAR (1.3%) than from open repair (3.8%; p=0.0001).14 Similar results were also found in a large discharge dataset analysis from New York State15 and in two recent randomized controlled trials from the Netherlands and the United Kingdom.16,17 In the Dutch study, the perioperative mortality was 1.2% in the EVAR group and 4.6% in the open group (p=0.055)16 and in the United Kingdom study, the mortality rates were 1.6% and 4.7% (p=0.003), respectively.17 This lower mortality after EVAR was confirmed in a meta-analysis of 61 studies including 29,059 patients that found an odds ratio for early death of 0.33 (95% confidence interval 0.26 – 0.42) of EVAR compared with open repair.18 However, in patients with poor health status, EVAR also has a substantial short-term mortality: a randomized trial of elderly patients unfit for open AAA repair found a 30-day mortality of 9% (13/150 patients) after EVAR.19

Rupture of AAA is life threatening. Mortality is over 90% without and 40 to 50% with open surgical repair.2,20 Small observational studies suggest a markedly lower short-term mortality after EVAR (11%)21 compared with open repair (40%),2 although data are limited and do not allow for a definitive conclusion.

Long-term outcome after EVAR

Unfortunately and unexpectedly for many perioperative physicians, there is no evidence that the advantages of EVAR in short-term mortality16-18 result in a better long-term outcome. Both of the recent randomized trials with a total of 1433 patients failed to show lower mortality after EVAR; two and four years after randomization, mortalities were 10%22 and 28%13 respectively, and similar in the EVAR and the open repair groups. In addition, EVAR was more expensive13,14 and was not associated with a better quality of life than open repair.13,23 Within four years of follow-up, 40% of the EVAR patients had postoperative complications compared with 9% of the open-repair patients.13 Similarly, secondary interventions were necessary in 20% of the EVAR patients but in only 6% of the open-repair patients.13 The excess rate of secondary interventions was also seen in observational studies24 and occurred mainly within the first year after the primary procedure.13,22 The high rate of late complications has important implications for surveillance (a CT scan at 1, 6, and 12 months after EVAR and annually thereafter is recommended),11 whereas long-term surveillance is not necessary after open repair.13

In patients considered unfit for open AAA repair, randomized to EVAR or no intervention in the EVAR-2 trial, EVAR was not associated with improvement in long-term mortality or quality of life but caused much higher expenses.19 However, this conclusion has been criticized because nearly half of the aneurysm-related deaths in the EVAR group occurred after randomization but before EVAR was performed.12,19 One long-term study of EVAR for treatment of ruptured AAA is promising,25 but results need to be verified with a larger sample size.

Conclusion: EVAR for AAA repair is a promising technique with favorable a short-term outcome. However, no benefit from EVAR has been proven on long-term outcome and quality of life, and EVAR is associated with a high rate of expensive re-intervention. Further research is needed to characterize patients who will receive long-term benefits from EVAR. As fro now, EVAR is best used in patients with a high perioperative risk.6,9,11,12,26 In younger patients with low perioperative risk, the decision to perform EVAR or open repair should be based on very careful evaluation of the anatomical suitability as well as taking into account the experience of the perioperative physicians involved and the patient's preference.12

More efforts need to be made to evaluate strategies that will transform the early survival advantage of EAVR into long-term benefit. Optimum risk factor management and medications (beta-receptor blockers, anti-platelet drugs, and statins) could be the important components needed to reach this end.

Pro continued from page 5

may be the ones who would be subjected for routine surveillance. With more manufacturers entering the stents arena, the cost of stents may very well go down. Importantly, when factoring in costs, one must also include the perioperative morbidity and their costs, such as blood transfusions, renal failure managements, ICU costs, etc. incurred by open procedures.

With increasing expertise, improvement in grafts types and efficacy, EVAR will remain as the procedure of first choice for patients coming with AAA. There will be a few patients where this may be contraindicated but their proportion can only be getting smaller and smaller. A comparison can be made with coronary stents, which are similar, and a number of patients may totally dodge the operating rooms because of the increasing efficacy of endo AAA stents.

While long-term data in these prospective trials are awaited, current state of technology and the available outcome data on endo AAA stenting procedures give a compelling evidence for increasing utility of EVAR in appropriate patients.

References on the next page

REFERENCES

PRO:

Reference:

1. Parodi JC, Palmaz JC, Barone HD. Transfemoral intraluminal graft implantation for abdominal aortic aneurysms. Ann Vasc Surg 1991;5:491-9.
2. Volodos NL, Karpovich IP, Troyan VI, et al. Clinical experience of the use of self-fixing prosthetics of the thoracic and the abdominal aorta and the iliac arteries through the femoral artery and as Intraoperative endoprosthesis for aorta reconstruction. Vasa Suppl 1991; 33: 93-95.
3. Blum U, Voshage G, Lammer J. Endoluminal stent-grafts for infrarenal abdominal aortic aneurysm. N Engl J Med 1997; 336:13-20.
4. Brewster DC, Geller SC, Kaufman JA, et al. Initial experience with endovascular aneurysm repair: comparison of early results with conventional open repair. J Vasc Surg 1998; 27:992-1005.
5. May J, White GH, Yu W, Ly CN, Waugh R, and Stephen MS, et al. Concurrent comparison of endoluminal versus open repair in the repair in the repair in the treatment of abdominal aortic aneurysms: analysis of 303 patients by life-table method. J Vasc Surg 1998; 27:213-21.
6. Moore W, Kashyap V, Vescer C. Abdominal aortic aneurysm: a 6-year comparison of endovascular versus transabdominal repair. Ann Surg 1999; 230:298-306.
7. Zarins CK, White RA, Schwa ten D, et al. AneuRX stent graft versus open surgical repair of abdominal aortic aneurysms: multicenter prospective clinical trial. J Vasc Surg 1999; 29:292-308.
8. Aquino RV, Jones MA,Zullo TG, et al. Quality of life assessment in patients undergoing endovascular or conventional AAA repair. J Endovasc Ther 2001; 8:521-8.
9. Lange C, Leurs LJ, Buth J, Myhre HO. Endovascular repair of abdominal aortic aneurysm in octogenarians: An analysis based on EUROSTAR data. J Vasc Surg 2005; 42: 624-30.
10. Greco G, Egorova N, Anderson PL, et al. Outcomes of endovascular treatment of ruptured abdominal aortic aneurysms. J Vasc Surg 2006; 43: 453-9.
11. Zeebregts CJ, Heekkerhen RH, Vander Palen J, et al. Outcome of AAA repair in the era of endovascular treatment. Br J Anesth 2004; 91: 563-8.
12. Wald R, Waikar SS, Liangos O, Pereira BJ, et al. Acute renal failure after endovascular vs. open repair of abdominal aortic aneurysm. J Vasc Surg 2006; 43: 460-6.
13. Manach YL, Perel A, Coriat P, et al. Early and delayed myocardial infarction after abdominal aortic surgery. Anesthesiology 2005; 102: 885-91.
14. Abraham N, Lemech L, Sandroussi C, Sullivan D, et al. A prospective study of subclinical myocardial damage in endovascular versus open repair of infrarenal abdominal aortic aneurysms. J Vasc Surg 2005; 41: 377-81.
15. Pearson S, Hasen T, Spark I, et al. Endovascular repair of abdominal aortic aneurysm reduces intraoperative cortisol and perioperative morbidity. J Vasc Surg 2005; 41: 919-25.
15. Prinssen M, Vehoeven ELG, Buth J, et al. A randomized trial comparing conventional and endovascular repair of abdominal aortic aneurysms (DREAM trial). NEJM 2004; 351: 1607-18.
16. EVAR trial participants. Endovascular aneurysm repair versus open repair in patients with abdominal aortic aneurysm (EVAR trial 1): randomized controlled trial. Lancet 2005; 365:2179-86.
17. Verhoeven ELG, Cina CS, Tielliu IFJ, et al. Local anesthesia for endovascular abdominal aortic aneurysm repair. J Vasc Surg 2005; 42: 402-9

REFERENCES

CON:

References

1. Isselbacher EM: Thoracic and abdominal aortic aneurysms. Circulation 2005; 111: 816-28
2. Filipovic M, Goldacre MJ, Roberts SE, Yeates D, Duncan ME, Cook-Mozaffari P: Trends in mortality and hospital admission rates for abdominal aortic aneurysm in England and Wales, 1979-1999. Br J Surg 2005; 92: 968-75
3. Ashton HA, Buxton MJ, Day NE, Kim LG, Marteau TM, Scott RA, Thompson SG, Walker NM: The Multicentre Aneurysm Screening Study (MASS) into the effect of abdominal aortic aneurysm screening on mortality in men: a randomised controlled trial. Lancet 2002; 360: 1531-9
4. Goldberg RJ, Glatfelter K, Burbank-Schmidt E, Lessard D, Gore JM: Trends in community mortality due to coronary heart disease. Am Heart J 2006; 151: 501-7
5. U.S. Preventive Services Task Force*: Screening for Abdominal Aortic Aneurysm: Recommendation Statement. Ann Intern Med 2005; 142: 198-202
6. Hirsch AT, Haskal ZJ, Hertzer NR, Bakal CW, Creager MA, Halperin JL, Hiratzka LF, Murphy WR, Olin JW, Puschett JB, Rosenfield KA, Sacks D, Stanley JC, Taylor LM, Jr., White CJ, White J, White RA, Antman EM, Smith SC, Jr., Adams CD, Anderson JL, Faxon DP, Fuster V, Gibbons RJ, Hunt SA, Jacobs AK, Nishimura R, Ornato JP, Page RL, Riegel B: ACC/AHA 2005 guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic): executive summary a collaborative report from the American Association for Vascular Surgery/Society for Vascular Surgery, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients With Peripheral Arterial Disease) endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. J Am Coll Cardiol 2006; 47: 1239-312
7. Parodi JC, Palmaz JC, Barone HD: Transfemoral intraluminal graft implantation for abdominal aortic aneurysms. Ann Vasc Surg 1991; 5: 491-9
8. Cuypers PW, Gardien M, Buth J, Peels CH, Charbon JA, Hop WC: Randomized study comparing cardiac response in endovascular and open abdominal aortic aneurysm repair. Br J Surg 2001; 88: 1059-65
9. Mordecai MM: Choice of invasive versus noninvasive surgery, In: Vascular Anesthesia, 2nd Edition. Edited by Kaplan JA, Lake CL, Murray MJ. Philadelphia, Churchill Livingstone, 2004, pp 125-132
10. Boyle JR, Thompson JP, Thompson MM, Sayers RD, Smith G, Bell PR: Improved respiratory function and analgesia control after endovascular AAA repair. J Endovasc Surg 1997; 4: 62-5
11. Katzen BT, Dake MD, MacLean AA, Wang DS: Endovascular repair of abdominal and thoracic aortic aneurysms. Circulation 2005; 112: 1663-75
12. Cronenwett JL: Endovascular aneurysm repair: important mid-term results. Lancet 2005; 365: 2156-8
13. Endovascular aneurysm repair versus open repair in patients with abdominal aortic aneurysm (EVAR trial 1): randomised controlled trial. Lancet 2005; 365: 2179-86
14. Lee WA, Carter JW, Upchurch G, Seeger JM, Huber TS: Perioperative outcomes after open and endovascular repair of intact abdominal aortic aneurysms in the United States during 2001. J Vasc Surg 2004; 39: 491-6
15. Anderson PL, Arons RR, Moskowitz AJ, Gelijns A, Magnell C, Faries PL, Clair D, Nowygrod R, Kent KC: A statewide experience with endovascular abdominal aortic aneurysm repair: Rapid diffusion with excellent early results. J Vasc Surg 2004; 39: 10-18
16. Prinssen M, Verhoeven EL, Buth J, Cuypers PW, van Sambeek MR, Balm R, Buskens E, Grobbee DE, Blankensteijn JD: A randomized trial comparing conventional and endovascular repair of abdominal aortic aneurysms. N Engl J Med 2004; 351: 1607-18
17. Greenhalgh RM, Brown LC, Kwong GP, Powell JT, Thompson SG: Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30-day operative mortality results: randomised controlled trial. Lancet 2004; 364: 843-8
18. Drury D, Michaels JA, Jones L, Ayiku L: Systematic review of recent evidence for the safety and efficacy of elective endovascular repair in the management of infrarenal abdominal aortic aneurysm. Br J Surg 2005; 92: 937-46
19. Endovascular aneurysm repair and outcome in patients unfit for open repair of abdominal aortic aneurysm (EVAR trial 2): randomised controlled trial. Lancet 2005; 365: 2187-92
20. Dueck AD, Kucey DS, Johnston KW, Alter D, Laupacis A: Survival after ruptured abdominal aortic aneurysm: effect of patient, surgeon, and hospital factors. J Vasc Surg 2004; 39: 1253-60
21. Hechelhammer L, Lachat ML, Wildermuth S, Bettex D, Mayer D, Pfammatter T: Midterm outcome of endovascular repair of ruptured abdominal aortic aneurysms. J Vasc Surg 2005; 41: 752-7
22. Blankensteijn JD, de Jong SE, Prinssen M, van der Ham AC, Buth J, van Sterkenburg SM, Verhagen HJ, Buskens E, Grobbee DE: Two-year outcomes after conventional or endovascular repair of abdominal aortic aneurysms. N Engl J Med 2005; 352: 2398-405
23. Prinssen M, Buskens E, Blankensteijn JD: Quality of life endovascular and open AAA repair. Results of a randomised trial. Eur J Vasc Endovasc Surg 2004; 27: 121-7
24. Elkouri S, Gloviczki P, McKusick MA, Panneton JM, Andrews J, Bower TC, Noel AA, Harmsen WS, Hoskin TL, Cherry K: Perioperative complications and early outcome after endovascular and open surgical repair of abdominal aortic aneurysms. J Vasc Surg 2004; 39: 497-505
25. Lachat ML, Pfammatter T, Witzke HJ, Bettex D, Kunzli A, Wolfensberger U, Turina MI: Endovascular repair with bifurcated stent-grafts under local anaesthesia to improve outcome of ruptured aortoiliac aneurysms. Eur J Vasc Endovasc Surg 2002; 23: 528-36
26. Woodburn KR, Chant H, Davies JN, Blanshard KS, Travis SJ: Suitability for endovascular aneurysm repair in an unselected population. Br J Surg 2001; 88: 77-81