Endovascular Stent Grafts for Abdominal Aortic Aneurysms

Policy Number: 7.01.67  Last Review: 6/2018

Policy
Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for endovascular grafts for abdominal aortic aneurysms when it is determined to be medically necessary because the criteria shown below are met.

When Policy Topic is covered
The use of endoprostheses approved by the U.S. Food and Drug Administration (FDA) as a treatment of abdominal aortic aneurysms may be considered medically necessary as a treatment of abdominal aortic aneurysms in any of the following clinical situations:
- an aneurysmal diameter greater than 5.0 cm
- an aneurysmal diameter of 4-5.0 cm that has increased in size by 0.5 cm in the last 6 months
- an aneurysmal diameter that measures twice the size of the normal infrarenal aorta
- a ruptured abdominal aortic aneurysm (See Considerations)

When Policy Topic is not covered
The use of endoprostheses approved by the FDA for all other indications is considered investigational when the above criteria are not met, including but not limited to the following clinical situations:
- Treatment of smaller aneurysms that do not meet the current recommended threshold for surgery
- Treatment of aneurysms that do meet the recommended threshold for surgery in patients who are ineligible for open repair due to physical limitations or other factors

Considerations
For treatment of ruptured abdominal aortic aneurysm with endoprostheses, several factors must be considered including the following:
- The patient must be sufficiently stable to undergo detailed CT examination for anatomic measurements,
- The aneurysm should be anatomically appropriate for endovascular repair, and
Specialized personnel should be available.

To monitor for leaking of the graft after implantation, patients will typically undergo routine imaging with either computed tomography or ultrasonography every 6 to 12 months, or more frequently if perivascular leaks or aneurysm enlargement is detected.

Coding

The overall procedure involves 4 steps: establishing vascular access, introducing catheters and guide wires into the arterial system, deploying the endoprosthesis, and radiologic supervision.

Step 1
The following CPT codes describe the establishment of vascular access; either the femoral or iliac arteries are used.

34812: Open femoral artery exposure for delivery of endovascular prosthesis, by groin incision; unilateral
34820: Open iliac artery exposure for delivery of endovascular prosthesis or iliac occlusion during endovascular therapy, by abdominal or retroperitoneal incision; unilateral

Step 2
The following CPT codes describe the introduction of catheters and guide wires:

CPT code 36200 (introduction of catheter, aorta) may be used. Sometimes the renal arteries are catheterized to ensure that they are not obstructed by the prosthesis. If this is the case, CPT code 36245 (selective catheter placement, arterial system, each first-order abdominal branch) may be used.

Step 3
The following CPT codes describe the deployment of the prosthesis:

34800: Endovascular repair of infrarenal abdominal aortic aneurysm or dissection; using aorto-aortic tube prosthesis
34802: ; using modular bifurcated prosthesis (1 docking limb)
34803: ; using modular bifurcated prosthesis (2 docking limbs)
34804: ; using unibody bifurcated prosthesis
34805: ; using aorto-uniliac or aorta-unifemoral prosthesis
34825: Placement of proximal or distal extension prosthesis for endovascular repair of infrarenal abdominal aortic aneurysm; initial vessel
34826: ; each additional vessel.

Step 4
The following CPT codes describe radiologic supervision:

75952: Endovascular repair of infrarenal abdominal aortic aneurysm or dissection, radiological supervision and interpretation
75953: Placement of proximal or distal extension prosthesis for endovascular repair of infrarenal abdominal aortic aneurysm, radiological supervision, and interpretation.

It is estimated that less than 5% of patients will be unsuccessfully treated with endovascular techniques to the extent that the patient must undergo urgent or emergent open surgical aneurysm repair. The following CPT codes describe this situation:

34830: Open repair of infrarenal aortic aneurysm or dissection, plus repair of associated arterial trauma, following unsuccessful endovascular repair; tube prosthesis
34831: aorto-bi-iliac prosthesis
34832: aorto-bifemoral prosthesis.

There are also category I codes for the use of fenestrated endografts to repair the visceral aorta (34841-34844) and the visceral aorta and infrarenal abdominal aorta (34845-34848).

34841: Endovascular repair of visceral aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) by deployment of a fenestrated visceral aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including one visceral artery endoprosthesis (superior mesenteric, celiac or renal artery)
34842: including two visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34843: including three visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34844: including four or more visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34845: Endovascular repair of visceral aorta and infrarenal abdominal aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) with a fenestrated visceral aortic endograft and concomitant unibody or modular infrarenal aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including one visceral artery endoprosthesis (superior mesenteric, celiac or renal artery)
34846: including two visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34847: including three visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34848: including four or more visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s]).

A code was created for the extra physician work involved in planning a patient-specific fenestrated visceral aortic endograft:

34839: Physician planning of a patient-specific fenestrated visceral aortic endograft requiring a minimum of 90 minutes of physician time.
Code 34839 cannot be reported on the day before or the day of the endovascular repair procedure.

### Description of Procedure or Service

<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals: ▪ With abdominal aortic aneurysms eligible for open repair</td>
<td>Interventions of interest are: ▪ Endovascular stent grafts</td>
<td>Comparators of interest are: ▪ Open repair</td>
<td>Relevant outcomes include: ▪ Overall survival ▪ Morbid events ▪ Treatment-related mortality ▪ Treatment-related morbidity</td>
</tr>
<tr>
<td>Individuals: ▪ With ruptured abdominal aortic aneurysms</td>
<td>Interventions of interest are: ▪ Endovascular stent grafts</td>
<td>Comparators of interest are: ▪ Open repair</td>
<td>Relevant outcomes include: ▪ Overall survival ▪ Morbid events ▪ Treatment-related mortality ▪ Treatment-related morbidity</td>
</tr>
<tr>
<td>Individuals: ▪ With abdominal aortic aneurysms not eligible for open repair</td>
<td>Interventions of interest are: ▪ Endovascular stent grafts</td>
<td>Comparators of interest are: ▪ Non-surgical therapy</td>
<td>Relevant outcomes include: ▪ Overall survival ▪ Morbid events ▪ Treatment-related mortality ▪ Treatment-related morbidity</td>
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Endovascular grafts are minimally invasive alternatives to open surgical repair for treatment of abdominal aortic aneurysms (AAAs). Open surgical repair of AAAs has high morbidity and mortality, and endovascular grafts have the potential to reduce the operative risk associated with AAA repair.

In individuals who have AAAs eligible for open repair who receive endovascular stent grafts, the evidence includes randomized controlled trials (RCTs). Relevant outcomes are overall survival, morbid events, and treatment-related morbidity and mortality. Evidence from RCTs comparing endovascular aneurysm repair (EVAR) with open repair for elective treatment of AAAs indicates that neither approach is clearly superior to the other. While EVAR is associated with an early reduction in morbidity and mortality, trials reporting outcomes at 5 years or longer have shown comparable survival rates for EVAR and open repair. Thus, the early advantage of EVAR is balanced out by a higher rate of late complications over the long term. In addition, 1 trial of patients at low-to-moderate surgical risk reported that the early benefit of EVAR was not evident in this population, raising the question of whether the early benefits of EVAR extend to patients at lower risk for open surgery. Based on these data, EVAR may be considered as an alternative to open surgery in patients who are candidates for both procedures. The evidence is sufficient to determine qualitatively that the technology results in a meaningful improvement in the net health outcome.

In individuals who have ruptured AAAs who receive endovascular stent grafts, the evidence includes RCTs and systematic reviews of RCTs. Relevant outcomes are overall survival, morbid events, and treatment-related morbidity and mortality. For patients with ruptured AAAs, evidence from 4 RCTs and a patient-level meta-
analysis indicates that short- and intermediate-term survival following EVAR is comparable with open repair. Evidence from RCTs and nonrandomized matched comparisons has shown that EVAR is associated with lower perioperative morbidity. The evidence is sufficient to determine qualitatively that the technology results in a meaningful improvement in the net health outcome.

In individuals who have AAAs not eligible for open repair who receive endovascular stent grafts, the evidence includes RCTs. Relevant outcomes are overall survival, morbid events, and treatment-related morbidity and mortality. At least 2 RCTs have compared EVAR to no surgical intervention in patients ineligible for open repair, either because of aneurysm size or prohibitive surgical risk. These trials did not report superior outcomes with EVAR and thus do not support use of EVAR in this population. The evidence is sufficient to determine qualitatively that the technology is unlikely to improve the net health outcome.

**Background**

The conventional management of a clinically significant abdominal aortic aneurysm consists of surgical excision with placement of a sutured woven graft. Surgical excision is associated with a perioperative mortality rate of 4%, which may rise to 10% in symptomatic patients. Due to this high mortality rate, endovascular prostheses have been investigated as a minimally invasive, catheter-based alternative to open surgical excision of abdominal aortic aneurysms. These devices are deployed across the aneurysm such that the aneurysm is effectively “excluded” from the circulation, with subsequent restoration of normal blood flow.

There are several types of graft currently under investigation—straight grafts, in which both ends are anchored to the infrarenal aorta, and bifurcated grafts, in which the proximal end is anchored to the infrarenal aorta and the distal ends are anchored to the iliac arteries. Recently, fenestrated grafts have also been investigated. These grafts are designed with openings in the wall that can be placed across the renal or celiac arteries while still protecting vessel patency through these critical arteries. In addition, extensions can be placed from inside the main endograft body into the visceral arteries to create a hemostatic seal.

**Regulatory Status**

A large number of endovascular grafts have been approved by the U.S. Food and Drug Administration (FDA) through the premarket approval (PMA) process for treatment of abdominal aortic aneurysms (see Table 1). The original PMA dates are shown. Most stents have undergone device modification, name changes, and have approved supplements to the original PMA. FDA product code MIH.

**Table 1. Abdominal Aortic Stent Grafts Approved by FDA**

<table>
<thead>
<tr>
<th><strong>Stent Name</strong></th>
<th><strong>PMA Applicant</strong></th>
<th><strong>Approval Date</strong></th>
<th><strong>PMA No.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>AneuRx® Prosthesis System (AneuRx AAAdvantage Stent Graft)</td>
<td>Medtronic Vascular</td>
<td>1999</td>
<td>P990020</td>
</tr>
<tr>
<td>Ancure® Aortoiliac System</td>
<td>Guidant Endovascular Technologies</td>
<td>2002</td>
<td>P990017</td>
</tr>
<tr>
<td>Gore® Excluder®</td>
<td>W.L. Gore &amp; Associates</td>
<td>2002</td>
<td>P020004</td>
</tr>
</tbody>
</table>
Rationale
This evidence review was originally created in July 1998 and has been updated regularly with searches of the MEDLINE database. This review was also informed by a 2001 TEC Assessment. The most recent literature update covers the period through March 23, 2017.

The main potential advantage of endovascular grafts for an abdominal aortic aneurysm (AAA) is that they offer a less invasive and less risky approach to the repair of abdominal aneurysms. An endovascular approach has the potential to reduce the relatively high perioperative morbidity and mortality associated with open AAA repair.

The use of endovascular grafts also has potential disadvantages. In particular, there are concerns about the durability of the anchoring system, aneurysm expansion, and other late complications related to the prosthetic graft. Aneurysm expansion may result from perivascular leaks, also known as endoleaks, which are a unique complication of endoprostheses. Perivascular leaks may result from an incompetent seal at one of the graft attachment sites, blood flow in aneurysm tributaries (these tributaries are ligated during open surgery), or perforation of graft fabric.

Endovascular Aneurysm Repair as an Alternative to Open Repair for Elective Treatment of AAAs
A number of moderate- to large-sized randomized controlled trials (RCTs) have compared endovascular aneurysm repair (EVAR) with open surgical repair, and these studies comprise the main body of literature on the comparative efficacy of the 2 procedures. Early reports of outcomes from these trials have demonstrated that the perioperative morbidity and mortality of an endovascular approach were reduced compared with open surgical repair. These results are consistent with large observational studies. However, the midterm results of these studies have suggested that the short-term improvements are not associated with a long-term benefit compared with an open approach.

Systematic Reviews
A 2014 Cochrane review assessed the evidence on the effectiveness of EVAR compared with open surgery for patients considered fit for surgery. Reviewers
identified 4 trials considered high quality that compared EVAR with open repair (OVER, DREAM, EVAR 1, ACE; total N=2790 patients). In a pooled analysis, short-term mortality (30-day or in-hospital mortality) was significantly lower in patients treated with EVAR (1.4% vs 4.2%; odds ratio [OR], 0.33; 95% confidence interval [CI], 0.2 to 0.55; p<0.001). There were no significant differences in mortality between EVAR and open repair groups at intermediate-term follow-up.

A 2017 individual patient data meta-analysis by Powell et al evaluated longer term outcomes from the 4 combined RCTs included in the 2014 Cochrane review (OVER, DREAM, EVAR-1, ACE), which are detailed below. The meta-analysis included 2783 patients with a median follow-up of 5.5 years. Mortality within 6 months of randomization was lower in the EVAR group, which was due primarily to a reduction in 30-day mortality (see Table 2). Beyond 3 years, aneurysm-related mortality was significantly higher in the EVAR group, resulting in a loss of survival benefit.

### Table 2. Mortality Following EVAR or Open Repair in the Individual Patient Data Meta-Analysis of the OVER, DREAM, EVAR 1, and ACE Trials

<table>
<thead>
<tr>
<th>Time of Follow-Up</th>
<th>EVAR n/N (%)</th>
<th>Open n/N (%)</th>
<th>HR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative total deaths</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-30 days</td>
<td>16/1373 (1.2%)</td>
<td>40/1351 (3.0%)</td>
<td>0.40</td>
<td>0.22 to 0.74</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>0-6 months</td>
<td>46/1393 (3.3%)</td>
<td>73/1397 (5.5%)</td>
<td>0.61</td>
<td>0.42 to 0.89</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>6 months to 4 years</td>
<td>244/1345 (18.1%)</td>
<td>229/1315 (17.4%)</td>
<td>1.04</td>
<td>0.87 to 1.25</td>
<td>NS</td>
</tr>
<tr>
<td>&gt;4 years</td>
<td>191/987 (19.4%)</td>
<td>180/958 (26.4%)</td>
<td>1.07</td>
<td>0.88 to 1.32</td>
<td>NS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aneurysm-related deaths</th>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>0-30 days</td>
<td>16/1373 (1.2%)</td>
<td>40/1351 (3.0%)</td>
<td>0.41</td>
<td>0.22 to 0.74</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>31 days to 3 years</td>
<td>18/1357 (1.3%)</td>
<td>33/1311 (2.5%)</td>
<td>1.07</td>
<td>0.49 to 2.36</td>
<td>NS</td>
</tr>
<tr>
<td>After 3 years</td>
<td>19/1118 (1.7%)</td>
<td>3/1054 (0.3%)</td>
<td>5.16</td>
<td>1.49 to 17.89</td>
<td>0.01</td>
</tr>
</tbody>
</table>

CI: confidence interval; EVAR: endovascular aneurysm repair; HR: hazard ratio.

Numerous nonrandomized studies have been performed, including the studies originally used as the basis for U.S. Food and Drug Administration (FDA) approval. A systematic review of nonrandomized studies that compared EVAR with open surgery in elderly patients, 80 years or older, was published in 2011. This analysis included observational studies of elderly patients who had undergone EVAR and compared results with observational studies of elderly patients who had open repair. Results of pooled analysis revealed that operative mortality was lower in the EVAR group (2.3%) than in the open surgery group (8.6%) and that EVAR also had lower rates of postoperative cardiac, pulmonary, and renal complications. Survival at 3 years did not differ between patients undergoing EVAR and open repair (relative risk, 1.10; 95% CI, 0.77 to 1.57).

**Randomized Controlled Trials**

The major RCTs that were included in the patient-level meta-analysis described above are OVER, DREAM, EVAR 1, and ACE. These are detailed next.
Open vs Endovascular Repair Trial

Long-term results of the Open Versus Endovascular Repair (OVER) trial were published by Lederle et al in 2012. In this trial, 881 patients with asymptomatic AAAs from multiple Veterans Administration medical centers were randomized to EVAR or to open repair and followed for a mean of 5.2 years. An early survival advantage was reported for EVAR of up to 3 years, but at final follow-up, mortality rates were similar between groups (hazard ratio [HR], 0.97; 95% CI, 0.77 to 1.22; p=0.81). On subgroup analysis, differences in mortality rates were noted by age. For patients younger than 70 years, mortality was higher in the EVAR group (HR=1.31; 95% CI, 0.99 to 1.73), while for patients older than 70 years, mortality was lower in the EVAR group (HR=0.65; 95% CI, 0.43 to 0.98).

Dutch Randomized Endovascular Aneurysm Management Trial

The Dutch Randomized Endovascular Aneurysm Management (DREAM) trial enrolled 351 patients who were randomized to endovascular or to open repair. The incidence of aneurysm-related death (ie, within 30 days) was 4.6% in the open repair group and 1.2% in the endovascular repair group. However, after 2 years, cumulative survival rates were 89.6% for open repair and 89.7% for endovascular repair, due to a higher incidence of late death in the endovascular group. The trialists suggested that an open approach may precipitate the mortality of frail patients who were most likely to die in the coming year and that the advantage of an endovascular approach may primarily be to delay death. Alternatively, the late mortality of endovascular repair may relate to its inferior ability to prevent rupture or prevent additional complications, compared with an open approach.

Longer term follow-up from this trial was reported in 2010. After 6 years of follow-up, survival rates were similar between the EVAR (68.9%) and the open repair (69.9%) groups (difference, 1 percentage point, 95% CI, -8.8 to 10.8; p=0.97). Reinterventions were more common in the EVAR group. Freedom from reinterventions was 70.4% for EVAR compared with 81.9% for open repair (difference, 11.5%; 95% CI, 2.0 to 21.0; p=0.03).

Endovascular Aneurysm Repair vs Open Repair in Patients With Abdominal Aortic Aneurysm Trial

A larger trial, the Endovascular Aneurysm Repair Versus Open Repair in Patients With Abdominal Aortic Aneurysm (EVAR 1) trial, enrolled 1082 patients 60 years or older with abdominal aneurysms at least 5.5 cm in diameter and randomized them to elective open or to endovascular repair. Similar to the DREAM trial, endovascular repair was associated with an improvement in aneurysm-related survival (4.7% open vs 1.7% endovascular at 30 days), but no advantage with respect to all-cause mortality and quality-of-life (QOL) measures. For example, within 4 years of follow-up, endoscopic repair was associated with a complication rate of 41% compared with only 9% in the surgically treated group.

Longer term follow-up from this trial was reported by the EVAR investigators in 2010. This follow-up included 1252 patients with aneurysms 5.5 cm or larger randomized to EVAR or to open repair. After 8 years of follow-up, there was no
difference in survival between the groups (HR=1.03; 95% CI, 0.86 to 1.23). This evidence has suggested that the early survival advantage of EVAR was lost over time due to late endograft ruptures, some of which were fatal.

Another follow-up from the EVAR 1 trial focused on cardiovascular morbidity and mortality at 5 years posttreatment. The EVAR group had a lower total cardiovascular event rate at all follow-up time points, but the difference during the trial was not statistically significant (HR=0.83; 95% CI, 0.62 to 1.10). During the period of 6 to 24 months postsurgery, the EVAR group had a higher rate of cardiovascular events (HR=1.44; 95% CI, 0.79 to 2.62), which attenuated the early benefit of EVAR and led to convergence of events between the 2 procedures. Cardiovascular mortality during the trial was similar between groups (HR=1.06; 95% CI, 0.83 to 1.36).

Anevrysme de l’aorte abdominale: Chirurgie versus Endoprothese Trial

The Anevrysme de l’aorte abdominale: Chirurgie versus Endoprothese (ACE) trial compared EVAR with open surgical repair in patients at low-to-moderate surgical risk. A total of 306 patients were randomized from 25 clinical centers in France. Selection criteria included a Society of Vascular Surgery comorbidity score of 0 to 2 and suitable anatomy for EVAR without high-risk features. There were 17 (11%) crossovers from open surgery to EVAR and 4 (3%) crossovers from EVAR to open surgery. Median follow-up was 3 years.

Perioperative mortality was 1.3% for the EVAR group and 0.6% for the open surgery group (p=0.12). Survival at 1 year was 95.2% for EVAR and 96.5% for open surgery (p=0.24). At 3 years, survival remained similar at 86.3% for EVAR and 86.7% for open surgery. Major adverse cardiovascular events were present in 6.7% of EVAR patients compared with 4.0% of open surgery, a difference that was also not significant. Reinterventions were more common with EVAR (16%) than with open surgery (2.7%; p<0.001). Endoleaks were identified on follow-up computed tomography (CT) scanning in 27% of EVAR patients (41/150). There were a total of 10 type I endoleaks; 5 were treated by endoluminal procedures, 2 were treated with open surgery, and 3 were treated by observation. There were a total of 31 type II endoleaks; 8 of these were treated with coil embolization and 23 were left untreated.

Nonrandomized Comparative Studies

In 2015, Schermerhorn et al published a propensity-matched study comparing EVAR with open repair in 79,932 Medicare patients. Matching was based on demographic and clinical variables available for the 2 years prior to the index procedure. Analysis of Medicare data showed that patients treated with EVAR had lower perioperative mortality (1.6% vs 5.2% p<0.001) and improved survival through the first 3 years of follow-up compared to patients treated with open repair. Survival rates between 3 and 8 years of follow-up did not differ between groups. Reasons for interventions through 8 years of follow-up differed, and were related to the management of the aneurysm after EVAR versus laparotomy after open repair. Aneurysm rupture occurred in a significantly greater proportion of patients after endovascular repair (5.4%) than in patients who had open repair.
(1.4%) through the 8-year follow-up (p<0.001). Interpretation of these data is limited by the potential for selection bias. While this study used propensity matching to reduce selection bias, the potential for bias in selecting patients for EVAR remains.

**Section Summary: Endovascular Aneurysm Repair as an Alternative to Open Repair for Treatment of AAAs**

Evidence from several RCTs and meta-analyses of the RCTs supports EVAR as a reasonable alternative to open surgical repair for aneurysms greater than 5.5 cm, and for aneurysms that have high-risk features such as rapid growth. In unselected patients with AAAs appropriate for surgery, EVAR is associated with lower perioperative morbidity and mortality. However, EVAR is associated with a higher rate of longer term complications, including endoleaks and the need for reinterventions. Longer term mortality is similar for EVAR and open surgery at 5 to 8 years of follow-up. For patients at low risk for open surgery, 1 RCT has reported low perioperative morbidity and mortality rates for both EVAR and open surgery, with no differences between the 2 procedures. Thus, the advantage for EVAR in reduced perioperative morbidity and mortality may not be present for patients who are low risk for surgery.

**EVAR as an Alternative to Open Repair for Ruptured AAAs**

Emergency EVAR for ruptured AAAs is being studied as a treatment option to decrease the high mortality rate associated with open surgical repair. RCTs are difficult in this area due to the emergent or semi-emergent nature of treatment for ruptured aneurysms. As a result, until 2013, the most relevant evidence on this question derived from nonrandomized studies comparing EVAR with open surgery. However, there is a high risk for selection bias in uncontrolled studies. Aneurysms that meet the anatomic criteria for EVAR tend to be smaller and less complex than aneurysms that do not, resulting in the highest risk patients being preferentially treated with open surgery. Some studies have attempted to identify the degree to which selection bias may contribute to apparent favorable outcomes in endovascular EVAR repair by comparing outcomes for patients who underwent open repair who met eligibility for EVAR with those who did not. In a study by Krenzien et al (2013), those who were suitable for EVAR had a significantly lower prevalence of in-hospital deaths (25%) compared with patients unsuitable for EVAR (53%; p=0.02). In contrast, in a 2014 observational cohort of 279 patients who underwent open repair of suspected ruptured AAAs who were enrolled in parallel to the Amsterdam Acute Aneurysm Trial (described below), 30-day morbidity was not lower among the 71 patients who met criteria for EVAR (38%) compared with the 208 patients who did not meet these criteria (30%; p=0.23). Because of the possibility of selection bias, several nonrandomized studies have used patient matching or other methods to reduce potential for selection bias.

Two RCTs, published in 2013 and 2014, have compared short-term results following endovascular with open repair for ruptured aneurysms. One-year follow-up from the Immediate Management of Patients with Rupture: Open Versus Endovascular Repair (IMPROVE) trial (described next) was published in 2015. Thirty-day and 1-year follow-up for a pseudo-randomized trial that compared
EVAR with open surgical repair in patients who qualified for EVAR was published in 2015.

**Systematic Reviews**

In 2015, Sweeting et al published a patient-level meta-analysis of 3 RCTs (total N=836 patients) that compared EVAR with open repair for ruptured AAAs. To have a more uniform comparison, 90-day data from only the patients who were anatomically suitable for EVAR from the IMPROVE trial were analyzed along with patient-level data from the AAA and ECAR trials (described below). There was no survival benefit from EVAR in pooled analysis at 90 days (OR=0.85; 95% CI, 0.64 to 1.13). However, pooled analysis confirmed findings from IMPROVE that women benefited more than men from an endovascular strategy (ratio of OR=0.49; 95% CI, 0.24 to 0.99). Pooled analysis also confirmed the individual findings of the 3 trials that hospital length of stay was shorter after EVAR than after open repair (HR=1.24; 95% CI, 1.04 to 1.47).

In a 2014 updated Cochrane review, Badger et al reviewed RCTs comparing emergency EVAR with surgical repair for clinically or radiologically diagnosed ruptured AAAs. Reviewers included 3 RCTs (n=761 patients), which consisted of the IMPROVE and AAA trials, along with a small 2006 pilot RCT (N=32 patients). The overall risk of bias was low, but 1 trial did not adequately report random sequence generation, putting it at risk of selection bias, 2 studies did not report on outcomes identified in their protocols, indicating reporting bias, and 1 study was underpowered. For the primary outcome of short-term (30-day or in-hospital) mortality, there was no significant difference between open repair and EVAR (OR=0.91; 95% CI, 0.67 to 1.22; p=0.52).

**Randomized Controlled Trials**

**Immediate Management of Patients With Rupture: Open vs Endovascular Repair Trial**

The IMPROVE trial randomized 623 patients at 30 centers (29 in the U.K., 1 in Canada) with a clinical diagnosis of a ruptured AAA to either an endovascular strategy of immediate CT and emergency EVAR, with open repair for patients anatomically unsuitable for EVAR (endovascular strategy group), or to the standard treatment of emergency open repair (open repair group). Patients were excluded if they had had an aneurysm repair, rupture of an isolated internal iliac aneurysm, aorto-caval or aorto-enteric fistulae, recent anatomic assessment of the aorta (eg, awaiting elective EVAR), a diagnosis of connective tissue disorder, or if the intervention was considered futile. The trial protocol permitted inclusion of hemodynamically unstable patients. Ten randomized patients were excluded from data analysis due to breach of inclusion criteria. Three hundred sixteen patients were randomized to EVAR, 275 (87%) of whom had a confirmed diagnosis of ruptured AAA and 174 (64%) were considered anatomically suitable for EVAR. EVAR was attempted in 154 patients, 4 of whom were converted to open repair. Open repair was attempted in 112 other patients (84 anatomically unsuitable for EVAR, 28 crossovers). Sixteen patients died before repair, and 1 patient refused repair and was discharged. Two hundred seventy-nine patients were randomized...
to open repair, 261 (88%) of whom had a confirmed diagnosis of ruptured AAA. In the open repair randomization group, open repair was attempted in 220 (80%) patients, EVAR was attempted in 36 (13%) patients, and 19 patients died before repair.

For the trial’s primary outcome, overall 30-day mortality was 35.4% (112/316) in the EVAR group and 37.4% (111/297) in the open repair group (unadjusted OR=0.92; 95% CI, 0.66 to 1.28; p=0.62). After adjustment for age, sex, and Hardman index, a prognostic score for mortality after ruptured AAA, there were no significant differences between groups for overall 30-day mortality (adjusted odds ratio [AOR], 0.94; 95% CI, 0.67 to 1.33; p=0.73). Compared with men (AOR=0.44), women demonstrated a greater benefit from EVAR (AOR=1.18; p=0.019 for interaction). There was a trend for lower mortality in the EVAR group for patients with higher Hardman index and age. Patients in the EVAR group (94%) were more likely to be discharged directly to home than those in the open repair group (77%; p<0.001).

One-year outcomes were reported in 2015.28 For the trial’s primary 1-year outcome, survival data were available for 611 of 613 patients randomized. All-cause mortality did not differ significantly between the EVAR (41.1%) and the open repair groups (45.1%; OR=0.85; 95% CI, 0.62 to 1.17; p=0.325), with similar reintervention rates in both groups.28 The EVAR group (17 days) had shorter hospital stays than the open repair group (26 days; p<0.001). QOL, measured with the EuroQoL questionnaire, was higher in the EVAR group than in the open group, with a mean difference of 0.087 (95% CI, 0.017 to 0.158) at 3 months and 0.068 (95% CI, -0.004 to 0.140) at 12 months. The EuroQoL outcome difference exceeded the minimally clinically important difference of 0.03.

**Amsterdam Acute Aneurysm Trial**

In 2013, Reimerink et al reported on results from the Amsterdam Acute Aneurysm (AAA) trial, a regional multicenter randomized trial that compared EVAR with open repair in the treatment of ruptured AAA.29 In this trial, patients were recruited from the set of all patients who presented with suspected ruptured AAA at 1 of 3 trial centers. The other 7 regional hospitals agreed to transfer patients with suspected ruptured AAA to one of the trial centers, if possible. After initial resuscitation, the diagnosis of a ruptured aneurysm was confirmed or rejected based on abdominal ultrasound and/or computed tomography angiography (CTA). Patients who were considered suitable for both EVAR and open repair by the treating vascular surgeon were randomized to EVAR or to open repair. Five hundred twenty patients were diagnosed with ruptured AAA in the trial region; of those, 365 patients were excluded (240 for unfavorable anatomy, 71 for lack of evaluation by CTA, 54 who were not referred to a trial center). One hundred fifty-five patients were considered to have favorable anatomy; 39 of them were excluded (16 were considered unfit for open repair, 11 for “logistics,” 7 with severe hemodynamic instability after CTA, 5 refused surgery). One hundred sixteen patients were randomized, 57 of whom were allocated to the EVAR group and 59 to the open repair group. Ten patients in the EVAR group underwent open
repair, and there was 1 perioperative death. In the open repair group, there were 3 diagnoses other than ruptured AAA during surgery and 4 perioperative deaths.

For the trial’s primary outcome, rates of a composite end point (death and severe complications at 30 days) were 42% (24/57) in the EVAR group compared with 47% (28/59) in the open repair group (absolute risk reduction [ARR], 5.4%; 95% CI, -13% to 23%). The 30-day mortality was 21% (12/57) in the EVAR group compared with 25% (15/59) in the open repair group (ARR=4.4%; 95% CI, -11% to 20%). The 2 groups had similar median hospital stay and likelihood of intensive care unit admission. The trialists noted that patients in the open repair group had a much lower 30-day mortality rate than was anticipated in the trial’s design (25% vs results from a prior meta-analysis demonstrating a mortality rate of 48.5% in subjects undergoing open repair of ruptured AAA). As such, the trial may have been underpowered to detect a difference between the groups. In addition, the trial had a high rate of exclusion of patients with ruptured aortic aneurysm, most commonly because of unfavorable infrarenal aortic neck anatomy with absent or very short necks and very wide necks.

Endovasculaire ou Chirurgie dan les Aneuvymes aorto-iliaques Rompus
In 2015, Desgranges et al reported on the 30-day and 1-year results of the multicenter Endovasculaire ou Chirurgie dan les Aneuvymes aorto-iliaques Rompus (ECAR) pseudo-randomized trial.30 A total of 107 patients were assigned by alternating weeks to EVAR (n=56) or open repair (n=51). Power analysis indicated that 80 patients per group would be required to detect a 20% reduction in mortality, however, trial enrollment was terminated after 5 years. Patients were included if they had a ruptured aortic, aorto-iliac, or iliac aneurysm, met clinical and anatomic criteria for both EVAR and open repair, and were hemodynamically stable. Assignment also included the availability of a qualified surgeon (≥15 EVAR procedures) and facilities. During the study period, 417 patients were treated for ruptured aorto-iliac aneurysms, of which 32% qualified for EVAR (56 included, 116 not included). Baseline characteristic were similar between the EVAR and open repair study groups. There was no significant difference between the EVAR and open repair group for the primary outcome of mortality at 30 days (18% vs 24%, p=0.239) or at 1 year (30% vs 35%, p=0.296), although the trial was underpowered to detect a difference of this magnitude. The lower than expected mortality rate in the open repair group may have been due to the exclusion of patients with hemodynamic instability or unfavorable anatomic criteria. Despite a longer delay to repair with EVAR compared to open surgery (2.9 hours vs 1.3 hours, p<0.005), EVAR resulted in a reduction in respiratory support time (59.3 hours vs 180.3 hours, p=0.007), pulmonary complications (15.4% vs 41.5%, p=0.05), total blood transfusion (6.8 units vs 10.9 units, p=0.020), and duration of intensive care unit stay (7 days vs 11.9 days, p=0.010).

Nonrandomized Comparative Studies
In 2014, Edwards et al published an evaluation of outcomes after EVAR and open repair for ruptured AAAs among traditional Medicare beneficiaries discharged from a U.S. hospital from 2001 to 2008.31 Overall, 10,998 patients underwent ruptured
AAA repair, 1126 by EVAR and 9872 by open repair. The population analyzed included 1099 patient pairs who were propensity-score matched based for baseline demographics, comorbid conditions, admission source, and hospital volume of ruptured AAA repair. Short-term mortality was significantly lower in the EVAR group (33.8% vs 47.7%, p<0.001). The survival benefit persisted until 4 years postsurgery. However, at 36 months after surgery, EVAR patients (10.9%) were more likely to have had AAA-related reinterventions than open repair patients (1.5%; p<0.001). Strengths of this trial included its large sample size, the availability of longer term follow-up data, and the use of propensity-score matching to reduce bias based on observed variables. However, the trial was subject to bias because unobserved variables might have been associated with the decision to perform open repair.

**Section Summary: EVAR as an Alternative to Open Repair for Ruptured AAAs**

For patients with ruptured AAAs to be candidates for endovascular repair, the lesions need to be suitable for the endovascular devices and patients need to be sufficiently stable to undergo CT evaluation. Three RCTs have published outcomes comparing EVAR with open surgery for patients with ruptured AAA and reported that the 30-day and 1-year mortality rates for EVAR did not differ significantly from those for open surgery. Longer term outcomes comparing EVAR with open surgery for ruptured aneurysms have not been reported.

**EVAR vs Nonsurgical Treatment for Smaller Aneurysms Not Meeting Current Size Criteria for Surgery or for Patients Ineligible for Open Surgery**

Few randomized trials have addressed patients with aneurysms that cannot be treated by open surgery. This population includes patients with smaller aneurysms that do not meet the size threshold for open surgery and patients who cannot undergo open surgery due to prohibitive operative risk.

**EVAR for Smaller Aneurysms**

**Systematic Reviews**

A 2012 Cochrane Review summarized the evidence on interventions for small aneurysms, 4.0 to 5.5 cm in size, either by open surgery or EVAR. Four RCTs were identified, including 2 RCTs on EVAR (discussed below) and 2 others on open surgical repair. Combined analysis of the 2 EVAR trials revealed no difference in mortality at 1 year (OR=1.15; 95% CI, 0.59 to 2.25). There was also no survival benefit for the trials of open surgery, nor was there any benefit apparent when all 4 trials were combined.

**Randomized Controlled Trials**

The CAESAR trial compared the use of EVAR for small AAAs, which did not meet the current thresholds recommended for intervention, with active surveillance. The study enrolled 360 patients, 50-to-79 years old, with aneurysms of 4.1 to 5.4 cm. Patients were randomized to early EVAR treatment or surveillance by ultrasound and/or CT. In the surveillance group, surgery was performed only after
the AAA met current recommendations for intervention (≥5.5 cm, growth 1 cm/year, or symptomatic). If repair was indicated, EVAR was performed unless the anatomy of the AAA was unsuitable for EVAR, in which case open repair was performed. Patients were followed for a median of 32.4 months for the primary outcome of all-cause mortality.

The primary outcome occurred at a lower rate than anticipated, thus limiting the power to detect a difference. At final follow-up, there was no significant difference in the main end point. Kaplan-Meier estimates of all-cause mortality were 10.1% for the surveillance group compared with 14.5% for the EVAR group (HR=0.76; 95% CI, 0.30 to 1.93). Aneurysm-related mortality, aneurysm rupture, and major morbidity rates were also similar between groups. For patients in the surveillance group, the Kaplan-Meier estimate of undergoing aneurysm repair was 59.7% at 36 months and 84.5% at 54 months.

A follow-up publication from the CAESAR trial reported on QOL outcomes. Patients were assessed with the 36-Item Short-Form Health Survey (SF-36) at baseline, 6 months, 12 months, and yearly after that with a mean follow-up of 31.8 months. Following EVAR, QOL scores in the EVAR arm rose while those in the observation arm declined. At 6-month follow-up, QOL scores in the EVAR group were significantly higher than in the observation group, with significant differences found for SF-36 overall score (mean difference [MD], 5.4, p=0.002), physical domain score (MD=3.8; p=0.02), and mental domain score (MD=6.0; p=0.001). Over longer periods of time, scores in both the EVAR and observation group declined, and the differences did not differ significantly at 1 year and beyond.

The PIVOTAL (Positive Impact of Endovascular Options for Treating Aneurysms Early) trial randomized 728 patients with AAAs of 4 to 5 cm to early EVAR or to ultrasound surveillance. Patients were followed for a mean 20 months for the primary outcomes of aneurysm rupture, aneurysm-related death, and overall mortality. At the final follow-up, overall mortality was the same in both groups (4.1%). Aneurysm rupture or aneurysm-related death occurred at a low rate and was also the same for both groups (0.6%). The hazard ratio for the primary outcome measures was 0.99 (95% CI, 0.14 to 7.06).

**EVAR for Patients at Prohibitive Surgical Risk**

A single 2005 RCT has compared endovascular repair for AAAs with no surgical intervention in patients unsuitable for open surgery. The U.K. EVAR Investigators published an RCT of EVAR versus no treatment of AAAs 5.5 cm or larger, but in whom surgery was not an option due to prohibitive surgical risk or patient preference. EVAR 2 randomized 338 patients to endovascular repair or medical management. Endovascular repair had a considerable 30-day operative mortality and did not improve survival over no intervention. However, the results of this trial were limited, because 20% of patients assigned to medical management underwent elective aneurysm repair in violation of the protocol. In addition, endovascular repair was not performed until a median of 57 days after randomization; during this period, 9 aneurysms ruptured, contributing to the endovascular mortality calculation, biasing results against endovascular repair.
A longer term follow-up for this trial was reported in 2010 on 404 patients randomized to EVAR or to no treatment. Perioperative mortality in the EVAR group was 7.3%. At the 8-year follow-up, aneurysm-related mortality was lower in the EVAR group, but overall mortality did not differ (HR=0.99; 95% CI, 0.78 to 1.27). There was a high rate of long-term complications in the EVAR group, with 48% of patients having a graft-related complication, and 27% of patients requiring reintervention for complications.

Based solely on the EVAR 2 trial, a 2006 Agency for Healthcare Research and Quality (AHRQ) report comparing endovascular with open surgical repair for AAA concluded that endovascular repair does not improve survival in patients who are medically unfit for open surgery. As previously discussed, the EVAR 2 trial, and thus the AHRQ assessment, was compromised by the high proportion of patients who crossed over from nonoperative to endovascular repair, and by the number of patients who died in the interval between randomization and treatment with EVAR. Professional guidelines (2006), based on both randomized and nonrandomized trials, have suggested that endovascular repair of infrarenal aortic and/or common iliac aneurysms is reasonable in patients at high risk of complication from open surgeries.

A subsequent Cochrane review (previously discussed) compared EVAR to best medical care for patients with AAA who were considered unfit for open repair. Only the EVAR 2 trial met reviewers’ inclusion criteria; they concluded that “the results of a single trial found no overall short- or long-term benefits of EVAR over no intervention with regard to all-cause mortality.”

Lim et al (2015) retrospectively compared outcomes after EVAR for 75 patients considered high risk based on criteria used in the EVAR 2 trial with 75 considered normal risk. While high-risk patients had larger aneurysms on average and a higher prevalence of comorbid diseases, perioperative mortality (0% for high risk vs 1.2% for normal risk; p=1.0) and early complication rates (4% for high risk vs 6% for normal risk; p=0.08) were similar between groups. These findings would suggest that EVAR may be feasible with reasonable outcomes in patients at high medical risk, but conclusions that might be drawn from this study are limited by its retrospective nature.

Section Summary: EVAR vs Nonsurgical Treatment for Smaller Aneurysms Not Meeting Current Size Criteria for Surgery or for Patients Ineligible for Open Surgery
The evidence does not indicate that EVAR improves outcomes for patients who are not suitable for open surgery, as judged by aneurysm size and or clinical factors that indicate prohibitive risk for open surgery. For small aneurysms, RCT evidence has suggested that morbidity and mortality outcomes from surveillance are as good as those from early intervention with EVAR. For patients at prohibitive operative risk, 1 RCT has reported that EVAR is associated with lower aneurysm mortality but no difference in overall mortality, and that there is a high rate of long-term complications and reinterventions with EVAR. This RCT evidence is
biased by a high rate of crossovers, primarily from open surgery to EVAR, which would limit the ability to detect a difference between the 2 treatments.

**Summary of Evidence**
For individuals who have abdominal aortic aneurysms (AAAs) eligible for open repair who receive endovascular stent grafts, the evidence includes randomized controlled trials (RCTs) and systematic reviews of RCTs. Relevant outcomes are overall survival, morbid events, and treatment-related mortality and morbidity. Evidence from a patient-level meta-analysis of 4 RCTs comparing endovascular aneurysm repair (EVAR) with open repair for elective treatment of AAAs has indicated that neither approach is clearly superior to the other. While EVAR is associated with an early reduction in mortality, outcomes at 5 years or longer have shown a greater endovascular mortality and comparable overall survival rates for EVAR and open repair. Thus, the early advantage of EVAR is balanced out by a higher rate of late complications over the long term. Based on these data, EVAR may be considered as an alternative to open surgery in patients who are candidates for both procedures. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have ruptured AAAs who receive endovascular stent grafts, the evidence includes RCTs and systematic reviews of RCTs. Relevant outcomes are overall survival, morbid events, and treatment-related mortality and morbidity. For patients with ruptured AAAs, evidence from 4 RCTs and a patient-level meta-analysis has indicated that short- and intermediate-term survival following EVAR is comparable with open repair. Evidence from RCTs and nonrandomized matched comparisons has shown that EVAR is associated with lower perioperative morbidity. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have AAAs ineligible for open repair who receive endovascular stent grafts, the evidence includes RCTs. Relevant outcomes are overall survival, morbid events, and treatment-related mortality and morbidity. At least 2 RCTs have compared EVAR to no surgical intervention in patients ineligible for open repair, either because of aneurysm size or prohibitive surgical risk. These trials did not report superior outcomes with EVAR and thus do not support use of EVAR in this population. The evidence is sufficient to determine that the technology is unlikely to improve the net health outcome.

**Supplemental Information**

**Practice Guidelines and Position Statements**

**European Society of Cardiology**
In 2014, the European Society of Cardiology issued guidelines on the diagnosis and treatment of aortic diseases, including abdominal aortic aneurysms (AAAs). These guidelines stated: “In patients with suitable anatomy, EVAR [endovascular aneurysm repair] is associated with a 66% reduction in operative mortality, a benefit that is lost during follow-up, and which comes at the cost of an increased
reintervention rate. For all other AAA aneurysms that are not suitable for EVAR, open repair remains the reference standard.”

**American College of Cardiology Foundation and American Heart Association**

Updated guidelines on the management of AAAs were released by the American College of Cardiology Foundation and the American Heart Association in 2011 as a focused update to the 2005 guidelines on the management of patients with peripheral artery disease. These guidelines made the following recommendations (see Table 3).

**Table 3. Guidelines on Management of Patients With Peripheral Artery Disease**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open or endovascular repair of infrarenal AAAs and/or common iliac aneurysms is indicated in patients who are good surgical candidates</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Periodic long-term surveillance imaging should be performed to monitor for endoleak, confirm graft position, document shrinkage or stability of the excluded aneurysm sac, and determine the need for further intervention in patients who have undergone endovascular repair of infrarenal aortic and/or iliac aneurysms</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Open aneurysm repair is reasonable to perform in patients who are good surgical candidates but who cannot comply with the periodic long-term surveillance required after endovascular repair</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Endovascular repair of infrarenal aortic aneurysms in patients who are at high surgical or anesthetic risk as determined by the presence of coexisting severe cardiac, pulmonary, and/or renal disease is of uncertain effectiveness</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>

AAA: abdominal aortic aneurysm; COR: class of recommendation; LOE: level of evidence.

**Society of Interventional Radiology et al**

Guidelines on the use of EVAR were developed jointly by the Society of Interventional Radiology, the Cardiovascular and Interventional Radiological Society of Europe, and the Canadian Interventional Radiology Association in 2010. These guidelines indicated that:

“Indications for EVAR are currently the same as open repair....”

“Patient preference for EVAR versus open repair should be considered when appropriate....”

“Endovascular abdominal aortic aneurysm repair should be considered as having an intermediate to high cardiac risk that ranges from 3% to 7%.”

There has been increasing use of EVAR for ruptured aneurysms. “Achieving optimal EVAR results for ruptured AAA requires establishment of a treatment protocol involving the emergency department, the endovascular team, anesthesiology, and the operating room personnel.”
“Lifelong imaging surveillance of patients after EVAR is critical for (i) the detection and, if possible, the characterization of endoleaks; (ii) evidence of expansion or shrinkage of the residual AAA sac through measurement of aneurysm size, volume calculation, and identification of substantial changes in aneurysm dimensions; (iii) detection of mechanical changes in the stent-graft, such as migration, kinking, or fracture; and (iv) evaluation of the long-term performance of the endoprosthesis.”

**Society for Vascular Surgery**
The Society for Vascular Surgery published guidelines for the treatment of AAAs in 2009. These guidelines indicated that open surgery and EVAR are options for patients with aneurysms that meet the current treatment threshold. These guidelines also contained the following statements and recommendations (see Table 4).

**Table 4. Guidelines on Management of Patients With Aneurysms**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>QOE</th>
<th>LOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAR is progressively replacing open surgery as the treatment of choice, and accounts for more than half of all elective AAA repairs in the United States</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>Emergent EVAR should be considered for treatment of a ruptured AAA, if anatomically feasible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVAR may be considered for high-risk patients unfit for surgical repair</td>
<td>Low</td>
<td>Weak</td>
</tr>
</tbody>
</table>


**U.S. Preventive Services Task Force Recommendations**
Not applicable.

**Medicare National Coverage**
There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.

**Ongoing and Unpublished Clinical Trials**
Some currently unpublished trials that might influence this review are listed in Table 5.

**Table 5. Summary of Key Trials**

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCT00583414</td>
<td>Endovascular Exclusion of Abdominal Aortic Aneurysms in High Risk Patients</td>
<td>400</td>
<td>Dec 2020</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.

References
1. Blue Cross and Blue Shield Association. Endovascular Stent-Grafts for Abdominal Aortic Aneurysm Repair. TEC Assessment Program. 2001;16(2).


**Billing Coding/Physician Documentation Information**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>34701</td>
<td>Endovascular repair of infrarenal aorta by deployment of an aorto-aortic tube endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, all endograft extension(s) placed in the aorta from the level of the renal arteries to the aortic bifurcation, and all angioplasty/stenting performed from the level of the renal arteries to the aortic bifurcation; for other than rupture (eg, for aneurysm, pseudoaneurysm, dissection, penetrating ulcer)</td>
</tr>
<tr>
<td>34702</td>
<td>Endovascular repair of infrarenal aorta by deployment of an aorto-aortic tube endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, all endograft extension(s) placed in the aorta from the level of the renal arteries to the aortic bifurcation, and all angioplasty/stenting performed from the level of the renal arteries to the aortic bifurcation; for rupture including temporary aortic and/or iliac balloon occlusion, when performed (eg, for aneurysm, pseudoaneurysm, dissection, penetrating ulcer, traumatic disruption)</td>
</tr>
<tr>
<td>34703</td>
<td>Endovascular repair of infrarenal aorta and/or iliac artery(ies) by deployment of an aorto-uni-iliac endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, all endograft extension(s) placed in the aorta from the level of the renal arteries to the iliac bifurcation, and all angioplasty/stenting performed from the level of the renal arteries to the iliac bifurcation; for other than rupture (eg, for aneurysm, pseudoaneurysm, dissection, penetrating ulcer)</td>
</tr>
<tr>
<td>34704</td>
<td>Endovascular repair of infrarenal aorta and/or iliac artery(ies) by deployment of an aorto-uni-iliac endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, all endograft extension(s) placed in the aorta from the level of the renal arteries to</td>
</tr>
</tbody>
</table>
the iliac bifurcation, and all angioplasty/stenting performed from the level of the renal arteries to the iliac bifurcation; for rupture including temporary aortic and/or iliac balloon occlusion, when performed (eg, for aneurysm, pseudoaneurysm, dissection, penetrating ulcer, traumatic disruption)

34705 Endovascular repair of infrarenal aorta and/or iliac artery(ies) by deployment of an aorto-bi-iliac endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, all endograft extension(s) placed in the aorta from the level of the renal arteries to the iliac bifurcation, and all angioplasty/stenting performed from the level of the renal arteries to the iliac bifurcation; for other than rupture (eg, for aneurysm, pseudoaneurysm, dissection, penetrating ulcer)

34706 Endovascular repair of infrarenal aorta and/or iliac artery(ies) by deployment of an aorto-bi-iliac endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, all endograft extension(s) placed in the aorta from the level of the renal arteries to the iliac bifurcation, and all angioplasty/stenting performed from the level of the renal arteries to the iliac bifurcation; for rupture including temporary aortic and/or iliac balloon occlusion, when performed (eg, for aneurysm, pseudoaneurysm, dissection, penetrating ulcer, traumatic disruption)

34707 Endovascular repair of iliac artery by deployment of an ilio-iliac tube endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, and all endograft extension(s) proximally to the aortic bifurcation and distally to the iliac bifurcation, and treatment zone angioplasty/stenting, when performed, unilateral; for other than rupture (eg, for aneurysm, pseudoaneurysm, dissection, arteriovenous malformation)

34708 Endovascular repair of iliac artery by deployment of an ilio-iliac tube endograft including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, and all endograft extension(s) proximally to the aortic bifurcation and distally to the iliac bifurcation, and treatment zone angioplasty/stenting, when performed, unilateral; for rupture including temporary aortic and/or iliac balloon occlusion, when performed (eg, for aneurysm, pseudoaneurysm, dissection, arteriovenous malformation, traumatic disruption)

34709 Placement of extension prosthesis(es) distal to the common iliac artery(ies) or proximal to the renal artery(ies) for endovascular repair of infrarenal abdominal aortic or iliac aneurysm, false aneurysm, dissection, penetrating ulcer, including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, and treatment zone angioplasty/stenting, when performed, per vessel treated (List
separately in addition to code for primary procedure)

34710 Delayed placement of distal or proximal extension prosthesis for endovascular repair of infrarenal abdominal aortic or iliac aneurysm, false aneurysm, dissection, endoleak, or endograft migration, including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, and treatment zone angioplasty/stenting, when performed; initial vessel treated

34711 Delayed placement of distal or proximal extension prosthesis for endovascular repair of infrarenal abdominal aortic or iliac aneurysm, false aneurysm, dissection, endoleak, or endograft migration, including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, and treatment zone angioplasty/stenting, when performed; each additional vessel treated (List separately in addition to code for primary procedure)

34712 Transcatheter delivery of enhanced fixation device(s) to the endograft (eg, anchor, screw, tack) and all associated radiological supervision and interpretation

34713 Percutaneous access and closure of femoral artery for delivery of endograft through a large sheath (12 French or larger), including ultrasound guidance, when performed, unilateral (List separately in addition to code for primary procedure)

34714 Open femoral artery exposure with creation of conduit for delivery of endovascular prosthesis or for establishment of cardiopulmonary bypass, by groin incision, unilateral (List separately in addition to code for primary procedure)

34715 Open axillary/subclavian artery exposure for delivery of endovascular prosthesis by infraclavicular or supraclavicular incision, unilateral (List separately in addition to code for primary procedure)

34716 Open axillary/subclavian artery exposure with creation of conduit for delivery of endovascular prosthesis or for establishment of cardiopulmonary bypass, by infraclavicular or supraclavicular incision, unilateral (List separately in addition to code for primary procedure)

34812 Open femoral artery exposure for delivery of endovascular prosthesis, by groin incision, unilateral

34813 Placement of femoral-femoral prosthetic graft during endovascular aortic aneurysm repair (List separately in addition to code for primary procedure)

34820 Open iliac artery exposure for delivery of endovascular prosthesis or iliac occlusion during endovascular therapy, by abdominal or retroperitoneal incision, unilateral

34839 Physician planning of a patient-specific fenestrated visceral aortic endograft requiring a minimum of 90 minutes of physician time

34841 Endovascular repair of visceral aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) by deployment of a fenestrated visceral aortic endograft and all associated radiological supervision and interpretation, including
target zone angioplasty, when performed; including one visceral artery endoprosthesis (superior mesenteric, celiac or renal artery)

34842 Endovascular repair of visceral aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) by deployment of a fenestrated visceral aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including two visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])

34843 Endovascular repair of visceral aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) by deployment of a fenestrated visceral aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including three visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])

34844 Endovascular repair of visceral aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) by deployment of a fenestrated visceral aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including four or more visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])

34845 Endovascular repair of visceral aorta and infrarenal abdominal aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) with a fenestrated visceral aortic endograft and concomitant unibody or modular infrarenal aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including one visceral artery endoprosthesis (superior mesenteric, celiac or renal artery)

34846 Endovascular repair of visceral aorta and infrarenal abdominal aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) with a fenestrated visceral aortic endograft and concomitant unibody or modular infrarenal aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including two visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])

34847 Endovascular repair of visceral aorta and infrarenal abdominal aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) with a fenestrated visceral aortic endograft and concomitant unibody or modular infrarenal aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including three visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])

34848 Endovascular repair of visceral aorta and infrarenal abdominal aorta (eg, aneurysm, pseudoaneurysm, dissection, penetrating ulcer,
intramural hematoma, or traumatic disruption) with a fenestrated visceral aortic endograft and concomitant unibody or modular infrarenal aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including four or more visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])

75952 Endovascular repair of infrarenal abdominal aortic aneurysm or dissection, radiological supervision and interpretation

75953 Placement of proximal or distal extension prosthesis for endovascular repair of infrarenal aortic or iliac artery aneurysm, pseudoaneurysm, or dissection, radiological supervision and interpretation

34830 Open repair of infrarenal aortic aneurysm or dissection, plus repair of associated arterial trauma, following unsuccessful endovascular repair; tube prosthesis

34831 Open repair of infrarenal aortic aneurysm or dissection, plus repair of associated arterial trauma, following unsuccessful endovascular repair; aorto-bi-iliac prosthesis

34832 Open repair of infrarenal aortic aneurysm or dissection, plus repair of associated arterial trauma, following unsuccessful endovascular repair; aorto-bifemoral prosthesis

36200 Introduction of catheter, aorta

36245 Selective catheter placement, arterial system; each first order abdominal, pelvic, or lower extremity artery branch, within a vascular family

ICD-10 Codes

171.3 Abdominal aortic aneurysm, ruptured

171.4 Abdominal aortic aneurysm, without rupture

172.3 Aneurysm of iliac artery

The overall procedure essentially involves 4 steps: establishment of vascular access, the introduction of catheters and guidewires into the arterial system, deployment of the endoprosthesis, and radiologic supervision.

1. The following CPT codes describe the establishment of vascular access; either the femoral or iliac arteries are used.
   - 34812: Open femoral artery exposure for delivery of endovascular prosthesis, by groin incision; unilateral
   - 34820: Open iliac artery exposure for delivery of endovascular prosthesis or iliac occlusion during endovascular therapy, by abdominal or retroperitoneal incision; unilateral

2. Introduction of catheters and guidewires
   - CPT code 36200 (introduction of catheter, aorta) may be used. Sometimes the renal arteries are catheterized to ensure that the renal arteries are not obstructed by the prosthesis. If this is the case, CPT code 36245 (selective catheter placement, arterial system, each first-order abdominal branch) may be used.
3. The following CPT code describes radiologic supervision
   - 75952: Endovascular repair of infrarenal abdominal aortic aneurysm or dissection, radiological supervision and interpretation
   - 75953: Placement of proximal or distal extension prosthesis for endovascular repair of infrarenal abdominal aortic aneurysm, radiological supervision, and interpretation.

It is estimated that less than 5% of patients will be unsuccessfully treated with endovascular techniques to the extent that the patient must undergo urgent or emergent open surgical aneurysm repair. The following CPT codes have been introduced to describe this situation:
   - 34830: Open repair of infrarenal aortic aneurysm or dissection, plus repair of associated arterial trauma, following unsuccessful endovascular repair; tube prosthesis
   - 34831: aorto-bi-iliac prosthesis
   - 34832: aorto-bifemoral prosthesis

Effective in 2014, there are category I codes for the use of fenestrated endografts to repair the visceral aorta (34841-34844) and the visceral aorta and infrarenal abdominal aorta (34845-34848). These codes replace the category III codes 0078T-0081T which were deleted.

34841: Endovascular repair of visceral aorta (e.g., aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) by deployment of a fenestrated visceral aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including one visceral artery endoprosthesis (superior mesenteric, celiac or renal artery)
34842: including two visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34843: including three visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34844: including four or more visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34845: Endovascular repair of visceral aorta and infrarenal abdominal aorta (e.g., aneurysm, pseudoaneurysm, dissection, penetrating ulcer, intramural hematoma, or traumatic disruption) with a fenestrated visceral aortic endograft and concomitant unibody or modular infrarenal aortic endograft and all associated radiological supervision and interpretation, including target zone angioplasty, when performed; including one visceral artery endoprosthesis (superior mesenteric, celiac or renal artery)
34846: including two visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34847: including three visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
34848: including four or more visceral artery endoprostheses (superior mesenteric, celiac and/or renal artery[s])
Effective in 2015, a code was created for the extra physician work involved in planning a patient-specific fenestrated visceral aortic endograft:

34839: Physician planning of a patient-specific fenestrated visceral aortic endograft requiring a minimum of 90 minutes of physician time.

Code 34839 cannot be reported on the day before or the day of the endovascular repair procedure.

Codes 34800, 34802, 34803, 34804, 34805, 34825, 34826 were deleted as of 1/1/2018.

Additional Policy Key Words
N/A

Policy Implementation/Update Information

5/1/06 New policy.
5/1/07 No policy statement changes.
6/1/07 Policy statement revised to indicate the use of ruptured abdominal aortic aneurysms is investigational.
5/1/08 No policy statement changes.
5/1/09 No policy statement changes.
5/1/10 Policy statement revised; may be considered medically necessary for ruptured abdominal aortic aneurysms.
5/1/11 No policy statement changes.
5/1/12 No policy statement changes.
5/1/13 No policy statement changes.
6/1/13 No policy statement changes.
4/1/14 Removed deleted codes 0078T, 0079T, 0080T, 0081T.
6/1/14 Added code 34805, updated coding information regarding endograft repair and deletion of category III codes 0078T-0081T. The second policy statement was editorially revised to clarify that situations that do not meet the criteria in the first policy statement would be considered investigational. No change to the intent of the policy.
6/1/15 No policy statement changes.
6/1/16 No policy statement changes.
6/1/17 No policy statement changes. Added the word “Stent” to the title and changed to: Endovascular Stent Grafts for Abdominal Aortic Aneurysms.
6/1/18 No policy statement changes.

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