

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
<p>1. Echeverria AB, Branco BC, Goshima KR, Hughes JD, Mills JL, Sr. Outcomes of endovascular management of acute thoracic aortic emergencies in an academic level 1 trauma center. <i>Am J Surg.</i> 2014;208(6):974-980; discussion 979-980.</p>	<p>Observational-Tx</p>	<p>22 patients</p>	<p>To evaluate the experience and outcomes in patients presenting with acute aortic catastrophes in a moderate-volume center.</p>	<p>During the study period, 51 patients underwent TEVAR; 22 cases (43.1%) were performed emergently (11 patients [50.0%] traumatic aortic injury; 4 [18.2%] ruptured descending thoracic aneurysm; 4 [18.2%] complicated type B dissection; 2 [9.1%] penetrating aortic ulcer; and 1 [4.5%] aortoenteric fistula). Overall, 72.7% (n = 16) were male with a mean age of 54.8 +/- 15.9 years. 19 patients (86.4%) required only a single TEVAR procedure, whereas 2 (9.1%) required additional endovascular therapy, and 1 (4.5%) open thoracotomy. 4 traumatic aortic injury patients required exploratory laparotomy for concomitant intra-abdominal injuries. During a mean hospital length of stay of 18.9 days (range, 1 to 76 days), 3 patients (13.6%) developed major complications. In-hospital mortality was 27.2%, consisting of 6 deaths from traumatic brain injury (1); exsanguination in the operating room before repair could be achieved (2); bowel ischemia (1) and multisystem organ failure (1); and family withdrawal of care (1). A stepwise logistic regression model identified 24-hour packed red blood cell requirements ≥4 units, admission mean arterial pressure <60 mm Hg, and 24-hour fresh frozen plasma to packed red blood cell ratio <1:1.5 as independent risk factors for death in this cohort. During a mean follow-up of 369 days (range, 35 to 957 days), no subsequent major complications or deaths occurred. All patients underwent serial CTA surveillance, and no device-related problems were identified during intermediate follow-up.</p>	<p>2</p>

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2. Shennib H, Rodriguez-Lopez J, Ramaiah V, et al. Endovascular management of adult coarctation and its complications: intermediate results in a cohort of 22 patients. <i>European Journal of Cardio-Thoracic Surgery</i> . 2010;37(2):322-327.	Review/Other-Tx	22 patients	To determine the safety and effectiveness of current endovascular treatment in adult patients with thoracic aortic coarctation and its complications.	10 patients with recently discovered de novo coarctations were treated with balloon-expandable stents, and an endoluminal graft was used in 1 additional patient. In the other 11 patients with recurrent lesions, 3 underwent repeat balloon dilation and stenting; 8 patients with recurrence with aneurysms received endoluminal grafts. The gradients across the coarctation decreased from 49 + 16 to 4 + 7 mmHg ($P=0.001$), and the diameters increased from 10 + 4 to 19 + 4mm ($P=0.001$). In 5 of the 8 patients (63%) with aneurysms, the endoluminal graft covered the subclavian artery, and a carotid subclavian bypass was necessary. 2 patients required iliac artery access. No early major complications occurred. At mean follow-up of 31 + 15.6 months, 1 patient with type II leak resolved spontaneously and another developed neck dilation and type I leak, requiring a second endoluminal graft placement. All patients except 1 had improvements in symptoms and better hypertension control.	4
3. Johnstone JK, Slaiby JM, Marcaccio EJ, Chong TT, Garcia-Toca M. Endovascular repair of mycotic aneurysm of the descending thoracic aorta. <i>Ann Vasc Surg</i> . 2013;27(1):23-28.	Review/Other-Tx	7 patients	To review the use of endovascular repair for mycotic thoracic aortic aneurysms.	7 patients underwent endovascular repair of mycotic thoracic aortic aneurysms. 1 patient died 2 days postoperatively, which gave an in-hospital survival rate of 85.7%. The 1-year survival rate was 71.4%. The mean follow-up time was 25 months (range, 0–72 months), with a survival rate at that time of 57.1%. All patients were free of infection during their follow-up period.	4
4. Okada K, Yamanaka K, Sakamoto T, et al. In situ total aortic arch replacement for infected distal aortic arch aneurysms with penetrating atherosclerotic ulcer. <i>J Thorac Cardiovasc Surg</i> . 2014;148(5):2096-2100.	Review/Other-Tx	9 patients	To present a series of patients who underwent in situ total aortic arch replacement for infected distal aortic arch aneurysms.	Average cardiopulmonary bypass time and lower body circulatory arrest time were 199.7 ± 50.7 minutes and 66.6 ± 13.8 minutes, respectively. There was no in-hospital mortality, but 1 patient died of asphyxia 5 months after hospital discharge. Freedom from recurrence of infection was 100%.	4

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5. Carpenter SW, Kodolitsch YV, Debus ES, et al. Acute aortic syndromes: definition, prognosis and treatment options. <i>The Journal of Cardiovascular Surgery</i> . 2014;55(2 Suppl 1):133-144.	Review/Other-Tx	N/A	To present the definition, prognosis, and treatment options for AAS.	AAS are life-threatening vascular conditions of the thoracic aorta presenting with acute pain as the leading symptom in most cases. The incidence is approximately 3–5/100,000 in western countries with increase during the past decades. Clinical suspicion for AAS requires immediate confirmation with advanced imaging modalities. Initial management of AAS addresses avoidance of progression by immediate medical therapy to reduce aortic shear stress. Proximal symptomatic lesions with involvement of the ascending aorta are surgically treated in the acute setting, whereas acute uncomplicated distal dissection should be treated by medical therapy in the acute period, followed by surveillance and repeated imaging studies. Acute complicated distal dissection requires urgent invasive treatment and TEVAR has become the treatment modality of choice because of favorable outcomes compared to open surgical repair. IMH, penetrating aortic ulcers, and traumatic aortic injuries of the descending aorta harbor specific challenges compared to aortic dissection and treatment strategies are not as uniformly defined as in aortic dissection. Moreover these lesions have a different prognosis. Once the acute period of aortic syndrome has been survived, a lifelong medical treatment and close surveillance with repeated imaging studies is essential to detect impending complications which might need invasive treatment within the short-, mid- or long-term.	4

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6. Desai ND, Burtch K, Moser W, et al. Long-term comparison of thoracic endovascular aortic repair (TEVAR) to open surgery for the treatment of thoracic aortic aneurysms. <i>J Thorac Cardiovasc Surg.</i> 2012;144(3):604-609; discussion 609-611.	Observational-Tx	151 patients	To compare the long-term outcomes of TEVAR with the 3 commercially available stents grafts for thoracic aortic aneurysms to results in control subjects undergoing open surgery.	During the study period (1995-2007) 106 patients were enrolled in TEVAR trials and there were 45 open controls. TEVAR patients were older and had significantly more comorbidities including diabetes and renal failure. TEVAR patients had 2.3 +/- 1.3 devices implanted. Mortality (2.6% TEVAR, 6.7% open; <i>P</i> =.1), paralysis/paraparesis (3.9% TEVAR, 7.1% open; <i>P</i> =.2), and prolonged intubation >24 hours (9% TEVAR, 24% open; <i>P</i> =.02) tended to be more common in the open controls. Overall survival at 10 years was similar between groups (log rank <i>P</i> =.5). Multivariate predictors of late mortality included age, chronic obstructive pulmonary disease, diabetes, and chronic renal failure. Use of TEVAR vs open surgery did not influence mortality (hazard ratio, 0.9 95% CI, 0.4–1.6). Over 5 years of radiographic follow-up in the TEVAR group, mean aortic diameter decreased from 61 to 55 mm. Freedom from reintervention on the treated segment was 85% in TEVAR patients at 10 years.	2

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7. Bianchini Massoni C, Geisbusch P, Gallitto E, Hakimi M, Gargiulo M, Bockler D. Follow-up outcomes of hybrid procedures for thoracoabdominal aortic pathologies with special focus on graft patency and late mortality. <i>J Vasc Surg.</i> 2014;59(5):1265-1273.	Observational-Tx	45 patients	To analyze midterm results of bypass patency and overall and aortic-related mortality rates of hybrid aortic procedures for thoracoabdominal aortic pathologies.	Technical success was achieved in 86.6% (39/45) of patients. 30-day morbidity rate was 60% (paraplegia/paraparesis: 13.3%, stroke: 6.7%, renal failure: 31.3%, permanent dialysis: 4.4%). 30-day freedom from reintervention rates were 67.1% and 78.5%, respectively. 30-day occlusion of revascularized visceral vessels occurred in 11 (7.1%, 11/155) target arteries. In-hospital mortality rate was 24.4%. Primary graft patency after 1, 2, and 4 years was 89.7%, 85.3%, and 79%, respectively. Bypass thrombosis or stenosis developed in 9 (6.8%, 9/132) vessels during follow-up. Of these, 3 patients required reintervention and 1 died. Freedom from reintervention rates after 1, 2, and 4 years were 45.6%, 45.6%, and 34.2%, respectively. Overall and aortic-related mortality rates after 1, 2, and 4 years were 32.6%, 41.4%, and 45.3% and 9.1%, 13.9%, and 13.9%, respectively.	2
8. Knepper J, Criado E. Surgical treatment of Kommerell's diverticulum and other saccular arch aneurysms. <i>J Vasc Surg.</i> 2013;57(4):951-954.	Review/Other-Tx	9 patients	To document hybrid repair in patients with diverse pathologies because of their infrequency.	3 patients presented with dysphagia from aberrant right subclavian arteries with aneurysm at the origin of the artery, 2 had asymptomatic aneurysms at the origin of the left subclavian, and 4 patients had isolated saccular aneurysms of the arch, 3 of whom presented with thoracic pain. A total of 16 extra-anatomic bypasses were done in the 9 patients. 10 endografts and 1 nitinol plug were used for exclusion in the 9 hybrid cases. There were no perioperative deaths, no strokes, or myocardial infarction events. During follow-up, 2 patients (22%) were found to have type II endoleaks, but no reinterventions were required. Symptoms resolved in 6 patients, whereas persistent dysphagia and pain occurred in 1.	4

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9. Prescott-Focht JA, Martinez-Jimenez S, Hurwitz LM, et al. Ascending thoracic aorta: postoperative imaging evaluation. <i>Radiographics</i> . 2013;33(1):73-85.	Review/Other-Tx	N/A	To review several open-repair techniques and their indications, as well as their normal and abnormal postoperative appearances at CTA.	Several abnormalities of the ascending aorta and aortic arch often require surgery, and various open techniques may be used to reconstruct the aorta, such as the Wheat procedure, in which both an ascending aortic graft and an aortic valve prosthesis are implanted; the Cabrol and modified Bentall procedures, in which a composite synthetic ascending aorta and aortic valve graft are placed; the Ross procedure, in which the aortic valve and aortic root are replaced with the patient's native pulmonary valve and proximal pulmonary artery; valve-sparing procedures such as the T. David-V technique, which leaves the native aortic valve intact; and more extensive arch repair procedures such as the elephant trunk and arch-first techniques, in which interposition or inclusion grafts are implanted, with or without replacement of the aortic valve. Normal postoperative imaging findings, such as hyperattenuating felt pledgets, prosthetic conduits, and reanastomosis sites, may mimic pathologic processes. Postoperative complications seen at CTA that require further intervention include pseudoaneurysms, anastomotic stenoses, dissections, and aneurysms.	4
10. Litmanovich D, Bankier AA, Cantin L, Raptopoulos V, Boiselle PM. CT and MRI in diseases of the aorta. <i>AJR Am J Roentgenol</i> . 2009;193(4):928-940.	Review/Other-Tx	N/A	To review the role of CT and MRI in the diagnosis, follow-up, and surgical planning of aortic aneurysms and AAS, including aortic dissection, IMH, and penetrating aortic ulcer. Also provide a systematic approach to the definition, causes, natural history, and imaging principles of these diseases.	No results stated in abstract.	4

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11. Jaussaud N, Chitsaz S, Meadows A, et al. Acute type A aortic dissection intimal tears by 64-slice computed tomography: a role for endovascular stent-grafting? <i>J Cardiovasc Surg (Torino)</i> . 2013;54(3):373-381.	Observational-Dx	17 patients	To identify physical characteristics of primary intimal tears in patients arriving to the hospital alive with acute type A aortic dissection using 64-multislice CT in order to determine anatomic feasibility of endovascular stent-grafting for future treatment.	Ascending aorta (29%) and sinotubular junction (29%) were the most frequent regions where intimal tears originated. Location of intimal tears in nearly 75% of patients was inappropriate for endovascular stent-grafting, and 94% of patients did not have sufficient proximal or distal landing zone required for secure fixation. Only 71% of patients underwent surgical aortic dissection repair after imaging and 86% of entry tears detected on multislice CT were confirmed on intraoperative documentation. Only 1 patient would have met all technical criteria for endovascular stent-grafting using currently available devices.	3

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12. Hanna JM, Andersen ND, Ganapathi AM, McCann RL, Hughes GC. Five-year results for endovascular repair of acute complicated type B aortic dissection. <i>J Vasc Surg.</i> 2014;59(1):96-106.	Observational-Tx	50 patients	To report long-term outcomes of TEVAR for acute (≤ 2 weeks from symptom onset) complicated type B dissection.	Indications for intervention included rupture in 10 (20%), malperfusion in 24 (48%), and/or refractory pain/impending rupture in 17 (34%). 1 patient (2%) had both rupture and malperfusion indications. 10 (20%) patients required 1 or more adjunctive procedures, in addition to TEVAR, to treat malperfusion syndromes. In-hospital and 30-day rates of death were both 0%; 30-day/in-hospital rates of stroke, permanent paraplegia/paraparesis, and new-onset dialysis were 2% (n = 1), 2% (n = 1), and 4% (n = 2), respectively. Median follow-up was 33.8 months [interquartile range, 12.3–56.6 months]. Overall survival at 5 and 7 years was 84%, with no deaths attributable to aortic pathology. 13 (26%) patients required a total of 17 reinterventions over the study period for type I endoleak (n = 5), metachronous aortic pathology (n = 5), persistent false lumen pressurization via distal fenestrations (n = 4), type II endoleak (n = 2), or retrograde acute type A aortic dissection (n = 1). Median time to first reintervention was 4.5 months (range, 0 days–40.3 months). Of the 17 total reinterventions, 6 (35%) were performed using open techniques and 11 (65%) with endovascular or hybrid methods; there was no difference in survival between patients who did or did not require reintervention.	3

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<p>13. Lavingia KS, Ahanchi SS, Redlinger RE, Udgiri NR, Panneton JM. Aortic remodeling after thoracic endovascular aortic repair for intramural hematoma. <i>J Vasc Surg.</i> 2014;60(4):929-935; discussion 935-926.</p>	<p>Review/Other-Tx</p>	<p>44 patients</p>	<p>To study the effect of TEVAR for IMH on aortic remodeling.</p>	<p>During the 6-year period, 44 patients underwent TEVAR for IMH. 25 patients had an IMH with concomitant penetrating atherosclerotic ulcer. There were 25 (57%) female patients. Mean age was 71 +/- 11 years and 40 (91%) patients had hypertension. Operative indications included intractable pain in 31 (70%), rapidly progressing IMH or conversion to dissection in 13 (30%), rupture in 10 (23%), and uncontrolled hypertension in 6 (14%). Technically successful TEVAR was performed in all patients with 42 (95%) reporting complete relief of symptoms. The 30-day mortality rate was 5% with a 5% rate of permanent paraplegia or paraparesis. At a mean follow-up of 26 months, there were no additional aortic-related deaths and overall survival was 80% with a reintervention rate of 11%. For our imaging analysis, 10 patients were excluded because of lack of follow-up imaging beyond 30 days. At a mean follow-up of 13 months, all measured data points were statistically improved from before to after TEVAR: thickness of IMH (12 mm vs 4 mm; $P=.01$), mean true lumen diameter (35 mm vs 37 mm; $P=.04$), mean total aortic diameter (47 mm vs 42 mm; $P=.02$), total aortic diameter/true lumen diameter ratio (1.35 vs 1.14; $P<.01$), and IMH volume (103 cm³ vs 14 cm³; $P<.01$). The mean Delta in total aortic diameter/true lumen diameter ratio from before to after TEVAR for the reintervention group was Delta0.14, and the mean Delta in total aortic diameter/true lumen diameter ratio for the nonreintervention group was Delta0.29 ($P=.05$). Analysis of patients with isolated IMH and those with concomitant penetrating atherosclerotic ulcer revealed no statistical differences.</p>	<p>4</p>

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14. Lombardi JV, Cambria RP, Nienaber CA, et al. Aortic remodeling after endovascular treatment of complicated type B aortic dissection with the use of a composite device design. <i>J Vasc Surg.</i> 2014;59(6):1544-1554.	Observational-Tx	86 patients	To report updated clinical and aortic remodeling results from the Study for the Treatment of complicated Type B Aortic Dissection using Endoluminal repair (STABLE) trial, a prospective, multicenter study evaluating safety and effectiveness of a pathology-specific endovascular system (proximal stent graft and distal bare metal stent) for the treatment of complicated type B aortic dissection.	The 30-day mortality rate was 4.7% (4/86) in the overall patient group (5.5% in acute patients and 3.2% in nonacute patients). Freedom from all-cause mortality was 88.3% at 1 year and 84.7% at 2 years (no significant difference between acute and nonacute patients). From baseline to 2 years, the true lumen diameter increased significantly in the descending thoracic aorta and the more distal abdominal aorta, along with a decrease in the false lumen diameter in both aortic segments. A majority of patients had either a stable or shrinking transaortic diameter in the thoracic (80.3% at 1 year and 73.9% at 2 years) or abdominal aorta (79.1% at 1 year and 66.7% at 2 years). Transaortic growth (>5 mm) occurred predominantly in acute dissections. Consistently, a shorter time from symptom onset to treatment was found to predict transaortic growth in the abdominal aorta ($P=.03$).	2
15. Merola J, Garg K, Adelman MA, Maldonado TS, Cayne NS, Mussa FF. Endovascular versus medical therapy for uncomplicated type B aortic dissection: a qualitative review. <i>Vasc Endovascular Surg.</i> 2013;47(7):497-501.	Review/Other-Tx	6 studies	To compare the outcomes of best medical therapy to TEVAR for uncomplicated type B dissections.	A total of 6 studies included 123 patients who underwent TEVAR/best medical therapy, and 566 patients who had best medical therapy alone. The mortality rates at 30 days (6.5% TEVAR/best medical therapy vs 4.8% best medical therapy, $P=.21$) and at 2 years (9.7% vs 11.9%, $P=.32$) were similar. Renal failure was greater in TEVAR/best medical therapy (15.4% vs 2.1%, $P<.01$). Rates of surgical reintervention/intervention were similar (17.6% vs 20.1%, $P=.31$).	4

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16. Watanabe S, Hanyu M, Arai Y, Nagasawa A. Initial medical treatment for acute type a intramural hematoma and aortic dissection. <i>Ann Thorac Surg.</i> 2013;96(6):2142-2146.	Observational-Tx	59 patients	To evaluate short-term clinical outcomes and predictors of adverse outcomes.	Survival, aortic death-free survival, and aortic event-free survival rates at 2 years were 90.0%, 96.6%, and 55.8%, respectively. Ascending aortic diameters, false lumen thickness of the ascending aortas, and rate of penetrating aortic ulcers in the ascending aortas were higher among patients with aortic events. The false lumen thickness ratio of the ascending aorta/false lumen thickness ratio of the descending aorta was also higher in these patients (1.3 +/- 0.9 vs 0.8 +/- 0.5, $P=0.0021$). Multivariate analysis revealed false lumen thickness ratio of the ascending aorta/false lumen thickness ratio of the descending aorta >0.98 (OR 5.35; 95% CI: 0.05 to 1.72; $P=0.0431$) as an independent predictor of aortic events. A false lumen thickness ratio of the ascending aorta/false lumen thickness ratio of the descending aorta >0.98 predicted aortic events with 87.1% sensitivity and 58.4% specificity.	2
17. Niclauss L, Delay D, von Segesser LK. Type A dissection in young patients. <i>Interact Cardiovasc Thorac Surg.</i> 2011;12(2):194-198.	Observational-Tx	27 patients	To perform a long-term follow-up that shows postoperative disease progression and lifelong consequences to understand the complex pathology of acute or chronic ascending aortic dissection and to identify potential risk factors.	A connective tissue disease was causative in 46% and a BAV was found in 22% of the patients. 14 patients had a Bentall procedure and 13 patients a simple prosthetic ascending aortic replacement. Early in-hospital mortality was, with 11%, lower than the average early mortality rate. 26% of patients developed neurological complications. During a mean follow-up of 117 months, 20 patients survived in good cardiac health (late mortality rate 8%). Aortic root dilatation was the main re-operation cause and occurred in almost 40% of patients after a simple prosthetic ascending aortic replacement.	2

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18. Regalado ES, Guo DC, Estrera AL, Buja LM, Milewicz DM. Acute aortic dissections with pregnancy in women with ACTA2 mutations. <i>Am J Med Genet A</i> . 2014;164A(1):106-112.	Review/Other-Tx	53 women	To perform a retrospective review of medical records of women with ACTA2 mutations to examine the frequency of aortic dissections, myocardial infarction, and stroke during pregnancy and the postpartum period.	Of the 53 women who had a total of 137 pregnancies, 8 had aortic dissections in the third trimester or the postpartum period (6% of pregnancies). 1 woman also had a myocardial infarct that occurred during pregnancy that was independent of her aortic dissection. Compared to the population-based frequency of peripartum aortic dissections of 0.6%, the rate of peripartum aortic dissections in women with ACTA2 mutations is much higher (8 out of 39; 20%). 6 of these dissections initiated in the ascending aorta (Stanford type A), 3 were fatal. 3 women had ascending aortic dissections at diameters <5.0 cm (range 3.8–4.7 cm). Aortic pathology showed mild to moderate medial degeneration of the aorta in 3 women. Of note, 5 of the women had hypertension either during or before the pregnancy.	4
19. Abdulkareem N, Soppa G, Jones S, Valencia O, Smelt J, Jahangiri M. Dilatation of the remaining aorta after aortic valve or aortic root replacement in patients with bicuspid aortic valve: a 5-year follow-up. <i>Ann Thorac Surg</i> . 2013;96(1):43-49.	Observational-Tx	359 patients	To identify dilatation of the remaining aorta after aortic valve replacement or aortic root replacement in patients with BAV compared with patients with tricuspid aortic valve.	Median ages of patients with BAV and patients with tricuspid aortic valve were 57 +/- 14 and 65 +/- 16 years, respectively ($P<0.05$). Preoperative diameter of ascending aorta in the BAV group with no aneurysm (3.5 cm; range, 3.0–4.0 cm; n = 143) was significantly higher than in the tricuspid aortic valve group (3.3 cm; range, 3.1–3.8 cm; n = 129) ($P<0.001$). In both BAV and tricuspid aortic valve groups with nonaneurysmal aortas who underwent aortic valve replacement, there was no significant expansion of the ascending aorta and arch at 5 years' follow-up. In patients with aneurysmal aorta (BAV group, n = 49; tricuspid aortic valve group, n = 74) who underwent aortic root replacement, there was also no significant difference in growth of the remaining aorta at 3 and 5 years' follow-up.	2

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20. Brown CR, Greenberg RK, Wong S, et al. Family history of aortic disease predicts disease patterns and progression and is a significant influence on management strategies for patients and their relatives. <i>J Vasc Surg.</i> 2013;58(3):573-581.	Observational-Dx	426 patients	To evaluate the influence of a family history of aortic disease with respect to the pattern and distribution of aortic aneurysms in a given patient.	Of the 555 patients who were alive and returning for follow-up, we obtained 426 (77%) family histories. 3D imaging studies were used to identify the presence of aneurysms; 36% (155/426) of patients had a family history of aortic aneurysms and 5% (21/155) had isolated intracranial aneurysms. A logistic regression model was used to compare aortic morphology between patients with a positive or negative family history for aneurysms. Patients with a positive family history of aortic aneurysms were younger at their initial aneurysm (63 vs 70 years; $P < .0001$), more frequently had proximal aortic involvement (root: OR, 5.4; $P < .0001$; ascending: OR, 2.9; $P < .001$; thoracic: OR, 2.2; $P = .01$) with over 50% of family history patients ultimately developing suprarenal aortic involvement ($P = .0001$) and had a greater incidence of bilateral iliac artery aneurysm (OR, 1.8; $P = .03$).	3
21. Eid-Lidt G, Gaspar J, Melendez-Ramirez G, et al. Endovascular treatment of type B dissection in patients with Marfan syndrome: mid-term outcomes and aortic remodeling. <i>Catheter Cardiovasc Interv.</i> 2013;82(7):E898-905.	Observational-Tx	10 patients	To evaluate the mid-term outcomes, and the aortic remodeling in Marfan Syndrome patients with type B dissection that were treated with endovascular repair.	The mean age was 35.1 ± 9.4 years and all patients presented with AAS complicating a chronic type B dissection (DeBakey type IIIb). 5 patients underwent a Bentall surgical procedure previous to endovascular repair, and in 4 patients initial TEVAR was followed by surgery of the ascending aorta. Treatment was limited to endovascular repair in only 1 patient. In-hospital mortality was 10%. At a mean follow-up of 59.6 ± 38.9 months, the cumulated mortality was of 20% and late mortality 11.1%. The rate of secondary endoleak was 44.4%, and late reintervention of 33.3%. Survival freedom from cardiovascular death at 8 years was 80.0%, and positive remodeling was documented in 37.5% of patients.	2

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22. Kim SW, Lee do Y, Kim MD, et al. Outcomes of endovascular treatment for aortic pseudoaneurysm in Behcet's disease. <i>J Vasc Surg.</i> 2014;59(3):608-614.	Observational-Tx	10 patients	To evaluate the effectiveness of endovascular stent grafting for surgical management of aortic pseudoaneurysm in patients with Behcet's disease.	From 1998 to 2012, 10 patients (8 male, 2 female; median age, 39) with Behcet's disease and aortic pseudoaneurysm were treated with endovascular stent grafting at this institution. 90% of these patients received immunosuppressive therapy before and after surgical treatment. The median follow-up period was 57 months (interquartile range, 43–72). The locations of the 12 pseudoaneurysms treated in this cohort were infrarenal abdominal aorta (7), descending thoracic aorta (4), and aortic arch (1). Median pseudoaneurysm size was 4.5 cm (interquartile range, 3.4–5.9). At long-term follow-up, complete resolution of the aortic pseudoaneurysm was noted in all patients. No endoleaks occurred. Newly developed pseudoaneurysm at the distal margin of the stent graft was noted in 1 patient 17 months after the stent graft procedure. 1 patient required a subsequent stent graft placement for an expanding pseudoaneurysm of the subclavian artery. No patient deaths occurred during the follow-up period.	2

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23. Perera AH, Youngstein T, Gibbs RG, Jackson JE, Wolfe JH, Mason JC. Optimizing the outcome of vascular intervention for Takayasu arteritis. <i>Br J Surg.</i> 2014;101(2):43-50.	Observational-Tx	97 patients	To analyze indications and outcomes of surgical intervention and to assess the potential benefits of immunosuppression and the use of perioperative imaging.	A series of 97 patients with Takayasu arteritis, seen at a single tertiary center, is reported. Immunosuppression was required in 87 patients (90%). 37 (38%) underwent 64 procedures: 27 patients underwent 33 open surgical procedures and 20 patients had 31 endovascular procedures. After a median follow-up of 6 years, the overall success rate was 79% for open surgery (mean graft patency 9.4 years) and 52% for endovascular procedures ($P=0.035$). Procedural failure was significantly reduced in patients receiving preoperative immunosuppression, and particularly endovascular procedures ($P=0.001$). In addition to clinical examination and measurement of acute-phase reactants, combination noninvasive imaging including Doppler US, FDG-PET and CT, MRA and CTA was used to identify arterial lesions, establish the diagnosis and monitor treatment outcomes.	2

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24. Zakko J, Scali S, Beck AW, et al. Percutaneous thoracic endovascular aortic repair is not contraindicated in obese patients. <i>J Vasc Surg.</i> 2014;60(4):921-928.	Observational-Tx	536 patients	To describe our experience with percutaneous -TEVAR and to compare outcomes in patients with or without obesity.	The review identified 536 patients, in whom 355 (66%) percutaneous -TEVAR procedures were completed (366 arteries; n = 40 [11%] bilateral). Compared with nonobese patients (n = 264), obese patients (n = 91) were typically younger (59 +/- 16 years vs 66 +/- 16 years; <i>P</i> = .0004) and more likely to have renal insufficiency (28% vs 17%; <i>P</i> = .05) or diabetes mellitus (19% vs 9%; <i>P</i> = .02). The number of Perclose deployments was similar between groups (<i>P</i> = NS). Mean sheath size (25.4F vs 25.0F; <i>P</i> = .04), access vessel inner diameters (8.5 +/- 1.9 mm vs 7.9 +/- 2.0 mm; <i>P</i> = .02), and vessel depth (50 +/- 20 mm vs 30 +/- 13 mm; <i>P</i> < .0001) were greater in obese patients. Adjunctive iliac stents were used in 7% of cases (10 [11%] in obese patients vs 16 [6%] in nonobese patients; <i>P</i> = .2). Overall technical success was 92% (92% for nonobese patients vs 93% for obese patients; <i>P</i> = .7). 3 patients required subsequent operations for access complications, 2 obese patients (2%) and 1 nonobese patient (0.4%) (<i>P</i> = .3). Independent predictors of failure were adjunctive iliac stent (OR, 9.5; 95% CI, 3.3–27.8; <i>P</i> < .0001), more than 2 Perclose devices (OR, 7.0; 95% CI, 2.3–21; <i>P</i> = .0005), and smaller access vessel diameter to sheath size ratio (OR multiplies by 1.1 for each .01 decrease in ratio; 95% CI, 1.02–1.2; <i>P</i> = .007) (area under the receiver operating characteristic curve = .75).	2
25. Bean MJ, Johnson PT, Roseborough GS, Black JH, Fishman EK. Thoracic aortic stent-grafts: utility of multidetector CT for pre- and postprocedure evaluation. <i>Radiographics.</i> 2008;28(7):1835-1851.	Review/Other-Dx	N/A	To discuss which patients are potential candidates for thoracic aortic stent-graft placement and demonstrate how multidetector CT with 2D multiplanar reformation and 3D rendering is relevant in preoperative imaging and postoperative assessment of thoracic aortic stent-grafts.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
26. Godoy MC, Cayne NS, Ko JP. Endovascular repair of the thoracic aorta: preoperative and postoperative evaluation with multidetector computed tomography. <i>J Thorac Imaging</i> . 2011;26(1):63-73.	Review/Other-Dx	N/A	To focus on the preoperative assessment of the pathologic aorta and evaluation after TEVAR.	No results stated in abstract	4
27. Baril DT, Cho JS, Chaer RA, Makaroun MS. Thoracic aortic aneurysms and dissections: endovascular treatment. <i>Mt Sinai J Med</i> . 2010;77(3):256-269.	Review/Other-Tx	N/A	To examine the currently available thoracic endografts, preoperative planning for TEVAR, and outcomes of TEVAR for the treatment of both thoracic aortic aneurysms and type B aortic dissections.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
28. Cochenec F, Kobeiter H, Gohel MS, et al. Impact of intraoperative adverse events during branched and fenestrated aortic stent grafting on postoperative outcome. <i>J Vasc Surg.</i> 2014;60(3):571-578.	Observational-Tx	113 patients	To report our experience of intraoperative adverse events during fenestrated and branched stent grafting and to analyze the impact on clinical outcomes.	During the study period, 113 consecutive elective patients underwent fenestrated or branched stent grafting. Indications for treatment were asymptomatic complex abdominal aortic aneurysms (n = 89) and thoracoabdominal aortic aneurysms (n = 24). Stent grafts included fenestrated (n = 79) and branched (n = 17) Cook stent grafts (Cook Medical, Bloomington, Ind), Ventana (Endologix, Irvine, Calif) stent grafts (n = 9), and fenestrated Anaconda (Vascutek Terumo, Scotland, UK) stent grafts (n = 8). In-hospital mortality rates for the complex abdominal aortic aneurysm and thoracoabdominal aortic aneurysm groups were 6.7% (6/89) and 12.5% (3/24), respectively. 28 moderate to severe complications occurred in 21 patients (18.6%). Spinal cord ischemia was recorded in 6 patients, 3 of which resolved completely. A total of 37 intraoperative adverse events were recorded in 34 (30.1%) patients (22 complex abdominal aortic aneurysms and 12 thoracoabdominal aortic aneurysms). Of 37 intraoperative adverse events, 15 (40.5%) resulted in no clinical consequence in 15 patients; 17 (45.9%) were responsible for moderate to severe complications in 16 patients, and 5 (13.5%) led to death in 4 patients. The composite end point death/nonfatal moderate to severe complication occurred more frequently in patients with intraoperative adverse events compared with patients without intraoperative adverse events (20/34 vs 12/79; $P < .0001$).	2

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
29. Eagleton MJ, Shah S, Petkosevek D, Mastracci TM, Greenberg RK. Hypogastric and subclavian artery patency affects onset and recovery of spinal cord ischemia associated with aortic endografting. <i>J Vasc Surg.</i> 2014;59(1):89-94.	Observational-Tx	1251 patients	To evaluate factors affecting outcomes from spinal cord ischemia associated with endovascular aortic aneurysm repair.	Spinal cord ischemia occurred in 2.8% (n = 36) of patients: abdominal aortic aneurysm, 0.3%, juxtarenal, 0.4%, thoracic aortic aneurysm, 4.6%, and thoracoabdominal aortic aneurysm, 4.8%). 4 (11%) required carotid-subclavian bypass prior to endografting, and 2 underwent coverage of the left subclavian artery. Unilateral hypogastric artery occlusion was present in 11 (31%) patients prior to endograft placement, and 3 had bilateral occlusions. An additional 7 patients had occlusion of at least 1 hypogastric artery during surgery. Spinal cord ischemia was apparent immediately in 15 (42%) patients. Immediate onset of symptoms was observed in 73% of patients with at least 1 occluded collateral bed but in only 24% of those with patent collateral beds (P=.021). Of those presenting in a delayed fashion, 9 (43%) had a clear precipitating event prior to onset of spinal cord ischemia (hypotension, n = 6, and segmental artery drain removal, n = 3). Recovery occurred in 24 (67%) patients, most within 7 days. Immediate presentation was a negative predictor of recovery (P=.025), as was occlusion of at least 1 collateral bed (P=.035). Mean follow-up was 22 +/- 4 months with 30-day and 1-year survival of 92 +/- 4.6% and 56 +/- 8.3%. Survival was only 36% at 3 months in those with permanent spinal cord ischemia compared with 92% (P<.001) in those with temporary symptoms.	2

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
30. Sadek M, Abjigitova D, Pellet Y, Rachakonda A, Panagopoulos G, Plestis K. Operative outcomes after open repair of descending thoracic aortic aneurysms in the era of endovascular surgery. <i>Ann Thorac Surg.</i> 2014;97(5):1562-1567.	Observational-Tx	68 patients	To assess the operative and long-term outcomes in a contemporary series of open repairs of descending thoracic aortic aneurysms.	In-hospital mortality was 3% (2 patients). There was no immediate paraplegia. Delayed paraplegia developed in 1 patient (1.5%). Postoperative stroke occurred in 3 patients (4.4%), and 20 (29%) required prolonged ventilatory support (intubation \geq 48 hours). New-onset renal insufficiency (creatinine \geq 2.5 mg/dL) developed postoperatively in 6 patients (9%), and 1 (1.5%) required temporary dialysis. The median follow-up time was 5.8+/-3.8 years. 16 of the 66 operative survivors (24.2%) died during follow-up. Probability of survival was 82% +/- 0.05% at 5 years and 67% +/- 0.07% at 10 years. Reintervention was necessary in 4 patients (6%). Freedom from reintervention was 98% +/- 0.02% at 5 years and 89% +/- 0.06% at 10 years. The univariable predictor of long-term death was postoperative reintubation ($P<0.05$).	2

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
31. Lu S, Lai H, Wang C, et al. Surgical treatment for retrograde type A aortic dissection after endovascular stent graft placement for type B dissection. <i>Interact Cardiovasc Thorac Surg.</i> 2012;14(5):538-542.	Review/Other-Tx	9 patients	To retrospectively investigate our experience of surgical treatment for retrograde type A aortic dissection after endovascular stent graft placement for type B dissection.	Between June 2006 and September 2011, 9 patients with retrograde type A aortic dissection were transferred to our department for surgery. Total arch replacement was performed in 6 patients and 3 patients underwent subtotal arch replacement. Associated procedures consisted of ascending aorta replacement in 9 patients, coronary artery bypass grafting in 1 patient and aortic valve plasty in 2 patients. All operations were performed under deep hypothermic circulatory arrest and selective antegrade cerebral perfusion. Cardiopulmonary bypass time was 158.33 +/- 29.18 min. The myocardial ischemic time was 78.11 +/- 28.30 min. The antegrade cerebral perfusion time was 38.67 +/- 12.34 min. The mean ventilation time was 45.63 +/- 24.74 h. A tracheotomy was necessary in 1 patient. The ICU time was 7.00 +/- 6.80 days and the in-hospital duration was 25.33 +/- 11.95 days. There was no in-hospital mortality. The mean follow-up was 34.79 +/- 19.37 months and 8 patients are still alive. 1 patient was lost to follow-up.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
32. Faure EM, Canaud L, Agostini C, et al. Reintervention after thoracic endovascular aortic repair of complicated aortic dissection. <i>J Vasc Surg.</i> 2014;59(2):327-333.	Observational-Tx	41 patients	To assess predictive factors for reintervention after TEVAR for complicated aortic dissection.	Between 2000 and 2011, 41 patients underwent TEVAR for a complicated aortic dissection involving the descending thoracic aorta. Primary indications included aneurysm >55 mm in 24, rapid aneurysmal enlargement or impending rupture in 6, saccular aneurysm >20 mm in 1, malperfusion in 1, intractable chest pain in 3, and rupture in 6. Technical success was achieved in 100%. The 30-day mortality rate was 5% (n = 2). 14 secondary procedures were performed in 13 patients (32%) for indications of device migration in 2, proximal type I endoleak in 5, distal type I endoleak in 2, type II endoleak in 1, aneurysmal evolution of the descending thoracic aorta in 2, aneurysmal expansion of the dissected abdominal aorta in 1, and retrograde dissection in 1. Multivariate analysis demonstrated that oversizing $\geq 20\%$ (OR, 16; $P=.011$), bare-spring stent in the proximal landing zone of the stent graft (OR, 12; $P=.032$), and anticoagulant therapy (OR, 78; $P=.03$) were significant factors for reintervention. On univariate analysis, large aneurysm was a risk factor for reintervention ($P=.002$), whereas complete false lumen thrombosis at the stent graft level was protective ($P<.05$).	2

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
33. Hughes GC, Ganapathi AM, Keenan JE, et al. Thoracic endovascular aortic repair for chronic DeBakey IIIb aortic dissection. <i>Ann Thorac Surg.</i> 2014;98(6):2092-2097; discussion 2098.	Review/Other-Tx	32 patients	To examine long-term results of TEVAR for this disorder including examination of anatomic features associated with TEVAR outcomes.	The mean interval from dissection to TEVAR was 32 +/- 44 months (range, 1 to 146 months). There were no 30-day or in-hospital deaths, strokes, or paraplegia. During a 54-month median follow-up, there were no aortic-related deaths. Significant thoracic aneurysm sac regression (>1 cm) in the intervened segment was observed in 89%. Thoracic remodeling was not correlated with the number of visceral vessels arising from the true lumen or the number or size of residual distal fenestrations; failure of thoracic remodeling was associated with fenestrations distal to the endograft(s) in the descending thoracic aorta, most often stent graft-induced new entry tears. Complete resolution of the thoracic and abdominal false lumen after TEVAR was observed in 15.6% (n = 5). All patients in this group had all visceral vessels arising from the true lumen and fewer than 3 residual distal fenestrations.	4
34. Mid-term outcomes and aortic remodelling after thoracic endovascular repair for acute, subacute, and chronic aortic dissection: the VIRTUE Registry. <i>Eur J Vasc Endovasc Surg.</i> 2014;48(4):363-371.	Observational-Tx	100 patients	To describe the mid-term clinical and morphological results of thoracic endovascular repair in patients with type B aortic dissection.	3-year all-cause mortality (18%, 4%, and 24%), dissection related mortality (12%, 4%, and 9%), aortic rupture (2%, 0%, and 4%), retrograde type A dissection (5%, 0%, and 0%), and aortic reintervention rates (20%, 22%, and 39%) were, respectively, defined for patients with acute (n = 50), subacute (n = 24), and chronic (n = 26) dissections. Analysis of aortic morphology observed that patients with subacute dissection demonstrated a similar degree of aortic remodeling to patients with acute dissection. Patients with acute and subacute dissection exhibited greater aortic plasticity than patients with chronic dissection.	2

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
35. Qing KX, Yiu WK, Cheng SW. A morphologic study of chronic type B aortic dissections and aneurysms after thoracic endovascular stent grafting. <i>J Vasc Surg.</i> 2012;55(5):1268-1275; discussion 1275-1266.	Observational-Tx	32 patients	To evaluate the morphology of stent graft and aorta remodeling and the volumetric changes in these patients after successful TEVAR.	Aortic stent grafts remodeled progressively, with inlet area increasing 4.4%, 10.1%, and 14.2% and outlet area increasing 42.6%, 67.2%, and 72.3%, respectively, at 6, 12, and 36 months. True lumen volume increased progressively in group A (114 to 174 mL) and group B (124 to 190 mL) from baseline to 36 months. False lumen volume decreased in group A (150 to 88 mL) and group B (351 to 250 mL), whereas thrombus load in the false lumen increased from 73% to 80% in group A and 84% to 87% in group B in 3 years. 8 patients (4 in each group) showed an increase in total aortic volume of >10%, 12 showed a static volume, and 12 showed shrinkage. Aortic volume change had no relationship to pathology, stent graft sizing, and thrombus load but was positively associated with the placement of a longer graft. A small but progressive distal migration of stent grafts was noted in all patients (3.1, 4.5, and 5.1 mm at 6, 12, and 36 months) but was more prominent in shorter stent grafts (≤162 mm). No deaths, rupture, or secondary interventions occurred during follow-up.	2
36. Rengier F, Geisbusch P, Vosshenrich R, et al. State-of-the-art aortic imaging: part I - fundamentals and perspectives of CT and MRI. <i>Vasa.</i> 2013;42(6):395-412.	Review/Other-Dx	N/A	To describe the imaging principles of CT and MRI with regard to aortic disease, show how both technologies can be applied in every day clinical practice, offer exciting perspectives.	No results stated in abstract.	4
37. American College of Radiology. ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA). Available at: http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Body_CTA.pdf . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4
38. Rengier F, Geisbusch P, Schoenhagen P, et al. State-of-the-art aortic imaging: Part II - applications in transcatheter aortic valve replacement and endovascular aortic aneurysm repair. <i>Vasa.</i> 2014;43(1):6-26.	Review/Other-Dx	N/A	To discuss the application of imaging, including preprocedural assessment and measurements as well as postprocedural imaging of complications.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
39. Stein E, Mueller GC, Sundaram B. Thoracic aorta (multidetector computed tomography and magnetic resonance evaluation). <i>Radiol Clin North Am.</i> 2014;52(1):195-217.	Review/Other-Dx	N/A	To review cross-sectional imaging of thoracic aorta.	No results stated in abstract.	4
40. Mendoza DD, Kochar M, Devereux RB, et al. Impact of image analysis methodology on diagnostic and surgical classification of patients with thoracic aortic aneurysms. <i>Ann Thorac Surg.</i> 2011;92(3):904-912.	Observational-Dx	50 subjects	To examine the impact of methodological variance on aortic quantification.	50 subjects were studied. Aortic size differed between axial and double oblique at all locations ($P \leq 0.001$), with magnitude greatest at the sinotubular junction (4.8 ± 1.1 vs 4.0 ± 1.0 cm, $P < 0.001$). The difference between axial and double oblique correlated with aortic angular displacement ($r = 0.37$, $P < 0.01$), which was threefold larger at the sinotubular junction (37 ± 12 degrees) than the ascending aorta (12 ± 5 degrees; $P < 0.001$). At all locations, aortic area calculated using double oblique yielded smaller differences with planimetry than axial ($P < 0.05$). Double oblique and planimetry yielded equal prevalence (24%) of subjects eligible for prophylactic thoracic aortic aneurysms repair based on area-height cutoff, whereas axial prevalence was higher (44%; $P = 0.006$). Using a linear cutoff, axial yielded over a twofold greater prevalence of surgically eligible subjects (56%) than did double oblique (24%; $P < 0.001$).	4
41. Maldjian PD, Partyka L. Intimal tears in thoracic aortic dissection: appearance on MDCT with virtual angioscopy. <i>AJR Am J Roentgenol.</i> 2012;198(4):955-961.	Review/Other-Dx	N/A	To illustrate the ability of multidetector CT using multiplanar image reformatting and virtual angioscopy to depict the location and appearance of intimal tears and fenestrations within dissection flaps in cases of thoracic aortic dissection.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
42. Chen CK, Liang IP, Chang HT, et al. Impact on outcomes by measuring tortuosity with reporting standards for thoracic endovascular aortic repair. <i>J Vasc Surg</i> . 2014;60(4):937-944.	Observational-Tx	77 patients	To assess the association between the tortuosity of the thoracic aorta as measured by the reporting standards for TEVAR, described by the Society for Vascular Surgery, and midterm outcomes after TEVAR for atherosclerotic aneurysms.	The mean follow-up period was 29 +/- 26 months. During this period, endoleaks occurred in 19 patients. Patients in the high-tortuosity group were at greater risk for endoleaks (OR, 9.95; 95% CI, 2.06–48.1; $P=.004$) and stroke (OR, 13.2; 95% CI, 1.03–169; $P=.047$) than those in the low-tortuosity group. The overall survival at 1, 3, and 5 years was 73%, 69%, and 63%, respectively, for the high-tortuosity group and 92%, 92%, and 86%, respectively, for the low tortuosity group.	2
43. Ueda T, Takaoka H, Raman B, Rosenberg J, Rubin GD. Impact of quantitatively determined native thoracic aortic tortuosity on endoleak development after thoracic endovascular aortic repair. <i>AJR Am J Roentgenol</i> . 2011;197(6):W1140-1146.	Observational-Dx	40 patients	To assess whether there is an association between native thoracic aortic curvature and the development of endoleaks after TEVAR.	Compared with patients without endoleaks, the tortuosity index of the proximal fixation zone was higher in patients with type Ia endoleak (9.5 vs 1.5 cm(-1), $P<0.01$); the tortuosity index of the distal fixation zone was higher in type Ib endoleak patients (6.6 vs 0.5 cm(-1), $P<0.05$); and the tortuosity indexes of the proximal fixation zone and of the diseased segment were higher in type III endoleak patients (11.0 vs 1.5 cm(-1), $P<0.01$; and 15.8 vs 7.2 cm(-1), $P<0.01$, respectively). Patients with a type III endoleak had longer diseased segments and larger mean diameters of the aneurysm than patients without endoleaks (148.6 vs 87.1 mm, $P<0.01$; and 75.4 vs 63.2 mm, $P<0.05$, respectively). Logistic regression analysis revealed that the risk of a type I or type III endoleak increased as the tortuosity index increased, with a 90% risk of endoleak at a tortuosity index of 10 cm(-1) in the proximal fixation zone.	2

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
44. Tolenaar JL, van Keulen JW, Trimarchi S, et al. Number of entry tears is associated with aortic growth in type B dissections. <i>Ann Thorac Surg.</i> 2013;96(1):39-42.	Observational-Dx	60 patients	To investigate whether the number of identifiable entry tears in acute type B aortic dissection patients is associated with aortic growth.	Included were 60 patients who presented with 243 dissected segments. Mean growth rates during follow-up (median, 23.2; range, 3 to 132 months) were significantly higher in patients with 1 entry tear (5.6 +/- 8.9 mm) than in those with 2 (2.1 +/- 1.7 mm; <i>P</i> =0.001) and 3 entry tears (mean 2.2 +/- 4.1; <i>P</i> =0.010). The distance of the primary entry tear from the left subclavian artery did not have an effect on the aortic growth rate (median, 38; interquartile range, 24 to 137 mm; <i>P</i> =0.434).	4
45. Mehta M, Darling RC, 3rd, Taggart JB, et al. Outcomes of planned celiac artery coverage during TEVAR. <i>J Vasc Surg.</i> 2010;52(5):1153-1158.	Review/Other-Tx	31 patients	To report our experience of planned celiac artery coverage during endovascular repair of complex thoracic aortic aneurysms.	31 of 228 (14%) patients with TEVAR required celiac artery interruption; 24 (77%) had demonstrable collaterals to the superior mesenteric artery. 12 (39%) of 31 patients underwent additional partial superior mesenteric artery coverage by stent graft, and proximal superior mesenteric artery stent. The majority of patients were females (n=20, 65%), the mean age was 74 years (range 55–87 years), and the mean thoracic aortic aneurysms size was 6.5 cm. Postoperative complications included visceral ischemia in 2 (6%) patients, paraplegia in 2 (6%) patients, and death in 2 (6%) patients. All type 1b endoleaks (n=2, 6%) and type 2 endoleaks vial retrograde flow from the celiac artery (n=3, 10%) were successfully treated by transfemoral coil embolization. Over a mean follow-up of 15 months, there have been no other complications of mesenteric ischemia, spinal cord ischemia, superior mesenteric artery in-stent stenosis, or conversion to open surgical repair.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
46. Hsu HL, Chen CK, Chen PL, et al. The impact of bird-beak configuration on aortic remodeling of distal arch pathology after thoracic endovascular aortic repair with the Zenith Pro-Form TX2 thoracic endograft. <i>J Vasc Surg.</i> 2014;59(1):80-88.	Observational-Tx	19 patients	To analyze the morphologic changes, conformability, and angulation factors in patients who underwent stainless steel-based stent graft repair of thoracic aortic pathology.	The treated diseases included chronic type B aortic dissection in 17 patients and degenerative aneurysms in 21. Significant arch angle transformation was noted at the zone 2 level between the Pro-Form and Z-Trak treated groups (150 degrees +/- 11 degrees vs 158 degrees +/- 6 degrees ; $P=.033$) and left subclavian artery level (152 degrees +/- 12 degrees vs 160 degrees +/- 8 degrees ; $P=.031$) during 1 year of follow-up. The bird-beak configuration was detected in 6 patients (32%) in the Pro-Form group and in 11 (58%) in the Z-Trak group ($P=.096$) at 1 month, and in 6 (32%) in the Pro-Form group and in 14 (74%) in the Z-Trak group ($P=.022$) at 12 months. The mean bird-beak angle was significantly less in Pro-Form-treated patients at 1 month (5 degrees +/- 9 degrees vs 15 degrees +/- 13 degrees ; $P=.019$) and at 1 year (6 degrees +/- 10 degrees vs 18 degrees +/- 15 degrees ; $P=.033$). In the Pro-Form platform, a preoperative zone 2 angle <151.1 degrees was a better estimation of the presence of a postoperative bird-beak configuration, with a sensitivity of 86% and specificity of 83%.	2
47. Finlay A, Johnson M, Forbes TL. Surgically relevant aortic arch mapping using computed tomography. <i>Ann Vasc Surg.</i> 2012;26(4):483-490.	Review/Other-Tx	45 patients	To map the aortic arch diameters, branch orientations, and center line distances using a commercially available 3D CT-based software package and to propose a prototype design.	The mode of the proximal diameters (2 cm and 4 cm distal to coronary artery) was 32 mm and 34 mm. The mode of the distance between the innominate and left common carotid arteries was 5 mm and 6 mm, and the mode of the distance between the left common carotid artery and left subclavian artery was 8 mm. Most commonly, the left common carotid artery was anterior to the other arch branches by 3 to 5 mm.	4
48. Orr N, Minion D, Bobadilla JL. Thoracoabdominal aortic aneurysm repair: current endovascular perspectives. <i>Vasc Health Risk Manag.</i> 2014;10:493-505.	Review/Other-Tx	N/A	To focus on the current state of endovascular thoracoabdominal aneurysm repair, including specific considerations in patient selection, operative planning, and perioperative complications.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
49. Bisdas T, Donas KP, Bosiers MJ, Torsello G, Austermann M. Custom-made versus off-the-shelf multibranched endografts for endovascular repair of thoracoabdominal aortic aneurysms. <i>J Vasc Surg.</i> 2014;60(5):1186-1195.	Observational-Tx	46 patients	To compare early outcomes between the custom-made and the new off-the-shelf multibranched endograft (mbEVAR, t-branch; Cook Medical, Bloomington, Ind) for the endovascular repair of thoracoabdominal aortic aneurysms.	Technical success was 100% in both groups. The 30-day mortality was 8% in group A (n = 2) and 0% in group B (P=.51). Survival rates at 6 months were 71% in group A (mean follow-up, 13 +/- 11 months) and 94% in group B (mean follow-up, 6 +/- 3 months; P=.04). There was only 1 procedure-related death caused by cerebral bleeding and herniation in group A. The freedom-from-reintervention rate at 6 months was 100% in group A (mean follow-up, 12 +/- 11.5 months) and 90% in group B (mean follow-up, 6 +/- 3.9 months; P=.07). No branch occlusions were observed in group A, whereas a branch occlusion occurred in 3 patients in group B (in all cases the bridging endograft for the renal artery). In 2 patients, the possible reason for branch occlusion was a thrombophilic disorder, whereas in 1 patient, the reason remains unknown. Paraplegia was observed in 1 patient in each group (group A: 4%; group B: 5%; P=.51) and persistent paraparesis in 2 patients in group A (8%) and in 1 patient (5%) in group B (P=.94).	1
50. Sonesson B, Landenhed M, Dias N, et al. Anatomic feasibility of endovascular reconstruction in aortic arch aneurysms. <i>Vascular.</i> 2015;23(1):17-20.	Review/Other-Dx	137 patients	To estimate the proportion of current open aortic arch reconstructions that might be feasible for endovascular repair.	Of 129 open cases, only 2 (1.5%) were suitable for endovascular repair. Among 137 all arch open and endovascular arch reconstructions performed during the study period, only 10 (7%) were candidates for endovascular repair. The most common exclusion for endovascular repair was an excessively large ascending aortic diameter.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
51. Alberta HB, Secor JL, Smits TC, et al. Comparison of thoracic aortic diameter changes after endograft placement in patients with traumatic and aneurysmal disease. <i>J Vasc Surg.</i> 2014;59(5):1241-1246.	Observational-Tx	124 patients	To evaluate acute changes in aortic size before and after endograft placement for traumatic injury and aneurysmal disease.	Mean increases in proximal (3.0 mm vs 2.0 mm; $P<.05$) and distal neck diameters (2.9 mm vs 0.7 mm; $P<.01$) after TEVAR are significantly greater in traumatic injury patients than in aneurysm patients between pretreatment and 30-day imaging. In both study populations, smaller pretreatment aortic neck diameters showed a larger change in neck diameter than did larger pretreatment aortic diameters. Aneurysm patients were oversized significantly more than were trauma patients at the proximal neck (9.1% vs 4.5%; $P<.05$). However, at the distal neck, the trauma patients were oversized more than were the aneurysm patients (17.5% vs 13.6%; $P=.06$). A strong correlation was found between the percentage of oversizing and change in the distal neck diameter after TEVAR in both patient groups.	2
52. Ye C, Chang G, Li S, et al. Endovascular stent-graft treatment for Stanford type A aortic dissection. <i>Eur J Vasc Endovasc Surg.</i> 2011;42(6):787-794.	Review/Other-Tx	45 cases	To summarize our experience of endovascular stent grafting for Stanford type A aortic dissection.	The surgical success rate was 97.8% (44/45) and 30-day mortality rate was 6.7% (3/45). Type I endoleaks occurred in 10 cases: 1 patient died intra-operatively, 4 were successfully treated with ballooning, 4 were sealed with aortic cuffs and 1 case caused by left subclavian artery (LSA) reflux was sealed with an occluder. Average follow-up time was 35.5 +/- 5.4 months. Up to the most recent review or death, 32 patients had complete thrombosis and 10 had partial thrombosis inside the false lumen. 2 deaths occurred after 30-days postoperatively.	4
53. Oderich GS, Picada-Correa M, Pereira AA. Open surgical and endovascular conduits for difficult access during endovascular aortic aneurysm repair. <i>Ann Vasc Surg.</i> 2012;26(7):1022-1029.	Review/Other-Tx	N/A	To summarize open surgical and endovascular alternatives to dealing with difficult iliofemoral access during endovascular aortic interventions.	No results stated in abstract.	4
54. Freeman LA, Young PM, Foley TA, Williamson EE, Bruce CJ, Greason KL. CT and MRI assessment of the aortic root and ascending aorta. <i>AJR Am J Roentgenol.</i> 2013;200(6):W581-592.	Review/Other-Dx	N/A	To provide an outline of aortic anatomy and disease patterns, describe methods of aortic measurement, and highlight measurement thresholds for surgical intervention.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
55. American College of Radiology. <i>Manual on Contrast Media</i> . Available at: http://www.acr.org/Quality-Safety/Resources/Contrast-Manual . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	4
56. Dill KE, George E, Abbara S, et al. ACR appropriateness criteria imaging for transcatheter aortic valve replacement. <i>J Am Coll Radiol</i> . 2013;10(12):957-965.	Review/Other-Dx	N/A	To evaluate several pre-intervention imaging examinations that focus on both imaging at the aortic valve plane and planning in the supra-avalvular aorta and iliofemoral system.	No results stated in abstract.	4
57. Fleischmann D, Chin AS, Molvin L, Wang J, Hallett R. Computed Tomography Angiography: A Review and Technical Update. <i>Radiol Clin North Am</i> . 2016;54(1):1-12.	Review/Other-Dx	N/A	To understand the principles of CTA and explain the technical aspects of CTA, including early contrast medium dynamics.	No results stated in abstract.	4
58. Midulla M, Fattori R, Beregi JP, Dake M, Rousseau H. Aortic dissection and malperfusion syndrome: a when, what and how-to guide. <i>Radiol Med</i> . 2013;118(1):74-88.	Review/Other-Dx	N/A	To present a when, what and how-to guide for all radiologists who encounter complicated aortic dissection.	No results stated in abstract.	4
59. Booher AM, Eagle KA, Bossone E. Acute aortic syndromes. <i>Herz</i> . 2011;36(6):480-487.	Review/Other-Dx	N/A	To review the relevant variants of AAS presentation, as well as diagnostic and management issues, including adequate long-term medical therapy and follow-up imaging.	No results stated in abstract.	4
60. Francois CJ, Tuite D, Deshpande V, Jerecic R, Weale P, Carr JC. Unenhanced MR angiography of the thoracic aorta: initial clinical evaluation. <i>AJR Am J Roentgenol</i> . 2008;190(4):902-906.	Observational-Dx	23 patients	To determine if an unenhanced 3D segmented steady-state free precession MRA technique would be an alternative to contrast-enhanced MRA for the evaluation of vasculature.	The difference in orthogonal measurements of the aortic diameter between those made on images from the 3D steady-state free precession and those made from the contrast-enhanced MRA sequences was -0.042 cm. The aortic root was better visualized with 3D steady-state free precession: score of 3.78 (of 5) for contrast-enhanced MRA vs score of 4.65 (of 5) for 3D steady-state free precession ($P<0.05$).	2
61. Boodhwani M, Andelfinger G, Leipsic J, et al. Canadian Cardiovascular Society position statement on the management of thoracic aortic disease. <i>Can J Cardiol</i> . 2014;30(6):577-589.	Review/Other-Dx	N/A	To provide recommendations for most patients and situations.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
62. American College of Radiology. ACR-SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation. Available at: http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Pregnant_Patients.pdf . Accessed March 1, 2017.	Review/Other-Dx	N/A	To provide current practical information to radiologists, other physicians, and medical practitioners implementing policies for imaging pregnant and potentially pregnant patients.	No results stated in abstract.	4
63. Tsagakis K, Konorza T, Dohle DS, et al. Hybrid operating room concept for combined diagnostics, intervention and surgery in acute type A dissection. <i>Eur J Cardiothorac Surg.</i> 2013;43(2):397-404.	Review/Other-Dx	1,883 cardiological and surgical patients	To present the results of the hybrid operating room concept encompassing simultaneous hemodynamic control, noninvasive and invasive diagnostics and immediate surgical and/or interventional treatment.	Preoperative angiography was performed in 71 patients, and no angiography related complications were observed during the procedure. A total of 32% (23/71) of these underwent coronary artery bypass graft for newly-diagnosed coronary artery disease in 21% of cases and for coronary malperfusion in 11%. Visceral/peripheral malperfusion syndromes, necessitating primary endovascular intervention, were detected in 23% (16/71). Ascending aorta replacement was performed in 100% (124/124) of patients, arch replacement in 88% (109/124) and descending aorta repair in 35% (44/124). 5 postoperative endovascular interventions became necessary due to persistent malperfusion. In-hospital mortality was 13% (12/90) in patients who had undergone preoperative invasive diagnostics and 24% (8/34) in patients who had not.	4
64. Clarencon F, Di Maria F, Cormier E, et al. Comparison of intra-aortic computed tomography angiography to conventional angiography in the presurgical visualization of the Adamkiewicz artery: first results in patients with thoracoabdominal aortic aneurysms. <i>Neuroradiology.</i> 2013;55(11):1379-1387.	Observational-Dx	30 patients	To compare the sensitivity of intra-aortic CTA to that of regular spinal digital subtraction angiography for the presurgical location of the Adamkiewicz artery.	The Adamkiewicz artery was visualized by the intra-aortic CTA in 27/30 cases (90%); in 26/31 (84%) cases, the continuity with the aorta was satisfactorily seen. Interrater agreement was good for the visualization of the Adamkiewicz artery and its feeder(s): 0.625 and 0.87, respectively. In 75% of the cases for which the Adamkiewicz artery was visualized, the selective catheterization confirmed the results of the intra-aortic CTA. In the remaining 25% of the cases, the selective catheterization could not be performed due to marked vessels' tortuosity or ostium stenosis.	2

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
65. Nienaber CA, Clough RE. Management of acute aortic dissection. <i>Lancet</i> . 2015;385(9970):800-811.	Review/Other-Tx	N/A	To review improved imaging, operative, and endovascular strategies for aortic dissection, both in diagnostic and therapeutic management.	No results stated in abstract.	4
66. Ganapathi AM, Englum BR, Schechter MA, et al. Role of cardiac evaluation before thoracic endovascular aortic repair. <i>J Vasc Surg</i> . 2014;60(5):1196-1203.	Observational-Tx	343 patients	To assess the adequacy of a limited cardiac evaluation before TEVAR, including assessment of cardiac symptoms, resting electrocardiography, and transthoracic echocardiography, as well as to estimate the incidence of perioperative cardiac events in patients undergoing TEVAR.	No preoperative cardiac workup was performed for 28 patients (7.4%); 127 patients (33.4%) had resting electrocardiography only, 208 patients (54.7%) had resting echocardiography, 12 patients (3.2%) underwent stress testing, and 5 patients (1.3%) had coronary angiography. Patients undergoing stress testing or coronary angiography were older and had a higher incidence of known coronary artery disease ($P<.01$) and prior myocardial infarction ($P=.01$). Complex hybrid aortic repairs and TEVAR for aneurysmal disease were more likely to have an extensive workup, whereas nonelective procedures more commonly had no workup. A total of 9 patients (2.4%) experienced a perioperative cardiac event (myocardial infarction or cardiac arrest), with no significant difference noted among all groups ($P=.45$), suggesting that the extent of cardiac workup was appropriate. The incidence of 30-day/in-hospital mortality (5.5%) and cardiac-specific mortality (0.8%) was similar among all groups.	2
67. Eriksson MO, Nyman R. The value of intravascular phased-array imaging in endovascular treatment of thoracic aortic pathology. <i>Acta Radiol</i> . 2011;52(3):285-290.	Review/Other-Tx	11 patients	To report our primary experiences of using intraluminal phased-array imaging as an additive tool for diagnostics and endovascular treatment of thoracic aortic pathology.	Intraluminal phased-array imaging could detect and visualize the entries and re-entries in the intima. Aortic branch vessels could be visualized for patency both during and immediately after stentgraft deployment. It was also possible to detect ceased blood flow in the false lumen or aneurysmal sac after stentgraft deployment.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
68. Bensley RP, Hurks R, Huang Z, et al. Ultrasound-guided percutaneous endovascular aneurysm repair success is predicted by access vessel diameter. <i>J Vasc Surg.</i> 2012;55(6):1554-1561.	Observational-Tx	168 patients	To describe our experience with percutaneous endovascular aneurysm repair and to compare our outcomes with the published literature.	168 patients (296 arteries) had percutaneous access endovascular aneurysm repair whereas 131 patients (226 arteries) had femoral cutdown access endovascular aneurysm repair. US scan-guided access was introduced in 2007. Percutaneous endovascular aneurysm repair increased from zero cases in 2005 to 92.3% of all elective cases in 2010. The success rate with percutaneous access was 96%. Failures requiring open surgical repair of the artery included 7 for hemorrhage and 6 for flow-limiting stenosis or occlusion of the femoral artery. Percutaneous endovascular aneurysm repair had fewer wound complications (0.7% vs 7.4%; $P=.001$), shorter operative time (153.3 vs 201.5 minutes; $P<.001$), and larger minimal access vessel diameter (6.7 mm vs 6.1 mm; $P<.01$). Patients with failed percutaneous access had smaller minimal access vessel diameters when compared to successful percutaneous endovascular aneurysm repair (4.9 mm vs 6.8 mm; $P<.001$). More failures occurred in small sheaths than large ones (7.4% vs 1.9%; $P=.02$). Access vessel diameter <5 mm is predictive of percutaneous failure (16.7% of vessels <5 mm failed vs 2.4% of vessels ≥ 5 mm failed; $P<.001$; OR, 7.3; 95% CI, 1.58-33.8; $P=.01$).	2

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
69. Trimarchi S, Tolenaar JL, Tsai TT, et al. Influence of clinical presentation on the outcome of acute B aortic dissection: evidences from IRAD. <i>J Cardiovasc Surg (Torino)</i> . 2012;53(2):161-168.	Observational-Tx	550 patients	To analyze the patients of the International Registry of Acute Aortic Dissection in order to clarify the influence of the clinical presentation on the outcome.	The overall in-hospital mortality among 550 patients was 12.4%. Mortality in group I (250 patients) was 20.0%, compared to 6.1% in group II (300 patients) ($P<0.001$). Univariate predictors of acute B aortic dissection complications were Marfan syndrome, abrupt onset of pain, migrating pain, any focal neurological deficits, need for higher number of diagnostic examinations and use of MR and/or aortogram, abdominal vessels involvement at aortogram, larger descending aortic diameter, especially >6 cm, pleural effusion, and widened mediastinum on chest x-ray. Univariate predictors of a noncomplicated status were normal chest x-ray and medical management. In group I, in-hospital mortality following surgical and endovascular intervention were 28.6% and 10.1% ($P=0.006$), respectively. Independent predictors of overall in-hospital mortality included age >70 years, female gender, electrocardiography showing ischemia, preoperative acute renal failure, preoperative limb ischemia, periaortic hematoma, and surgical management. The only independent variable protective for mortality was MR as diagnostic test.	2

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
70. Kato K, Nishio A, Kato N, Usami H, Fujimaki T, Murohara T. Uptake of 18F-FDG in acute aortic dissection: a determinant of unfavorable outcome. <i>J Nucl Med.</i> 2010;51(5):674-681.	Observational-Dx	28 patients	To investigate the use of FDG-PET/CT to predict short- and midterm outcomes in medically controlled acute aortic dissection patients.	Maximum dissection diameter in the unfavorable group was significantly greater than that in the favorable group ($P=0.0207$). On 50-min images, maximal and mean SUV at maximum aortic dissection sites were significantly greater for the unfavorable group than for the favorable group (all $P<0.01$). A stepwise-forward selection procedure demonstrated that the mean SUV at sites of maximum aortic dissection on 50-min images significantly and independently predicted an unfavorable outcome for acute aortic dissection ($P=0.0171$; OR, 7.72; 95% CI, 1.44–41.4; $R(2)=0.2372$). A mean SUV >3.029 had significant predictive power, with sensitivity of 75.0%, specificity of 70.0%, a PPV of 50.0%, a NPV of 87.5%, and accuracy of 71.4%. Greater uptake of FDG in acute aortic dissection was significantly associated with an increased risk for rupture and progression. FDG-PET/CT may be used to improve acute aortic dissection patient management, although more studies are still needed to clarify its role in this clinical scenario.	3
71. Matsumura JS, Melissano G, Cambria RP, et al. Five-year results of thoracic endovascular aortic repair with the Zenith TX2. <i>J Vasc Surg.</i> 2014;60(1):1-10.	Observational-Tx	230 patients	To evaluate TEVAR compared with open surgical repair of descending thoracic aortic aneurysms and large ulcers at 42 international sites.	Although follow-up was limited, 5-year mortality rate was similar at 37% for both groups. Aneurysm-related mortality rate was 5.9% with TEVAR compared with 12% with open surgical repair ($P=.11$). There were no ruptures of the treated aneurysms in either group or open conversions in the TEVAR group. Predefined severe morbidity occurred at a significantly lower rate in TEVAR (21%) compared with open surgical repair (39%; $P<.001$). Aneurysm growth was seen by core laboratory in 5.9% of patients and endoleak in 5.7% of patients. Secondary intervention rates were similar between TEVAR (8%) and open surgical repair (12%; $P=.49$) patients.	1

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
72. Flors L, Leiva-Salinas C, Norton PT, Patrie JT, Hagspiel KD. Endoleak detection after endovascular repair of thoracic aortic aneurysm using dual-source dual-energy CT: suitable scanning protocols and potential radiation dose reduction. <i>AJR Am J Roentgenol.</i> 2013;200(2):451-460.	Observational-Dx	48 patients	To evaluate the diagnostic performance of dual-source dual-energy CT in the detection of endoleaks after TEVAR for thoracic aortic aneurysm and to investigate if a double-phase (arterial and dual-energy late delayed phase) or a single-phase (dual-energy late delayed phase) acquisition can replace the standard triphasic protocol.	48 patients (mean age, 66 years; age range, 19–84 years) underwent 74 triple-phase CT examinations. The single-phase studies (session B) were characterized by 85.7% sensitivity, 100% specificity, 100% NPV, and 94.6% PPV. The dual-phase study (session C) revealed 100% sensitivity, 100% specificity, 100% NPV, and 100% PPV. The use of the dual-phase protocol and single-phase protocol resulted in a radiation exposure reduction of 19.5% and 64.1%, respectively.	3
73. Kret MR, Azarbal AF, Mitchell EL, Liem TK, Landry GJ, Moneta GL. Compliance with long-term surveillance recommendations following endovascular aneurysm repair or type B aortic dissection. <i>J Vasc Surg.</i> 2013;58(1):25-31.	Review/Other-Tx	204 patients	To determine factors associated with failure to obtain recommended lifelong surveillance for both endovascular aneurysm repair and acute.	204 patients, median age 71.9 years, were identified; 171 had endovascular aneurysm repair and 33 had type B dissection. endovascular aneurysm repair patients included 45 thoracic, 100 abdominal, and 12 thoracoabdominal endografts, as well as 7 iliac artery aneurysm repairs and 7 proximal/distal graft extensions. Median follow-up was 28 +/- 10.5 months. Overall, 56% were lost to follow-up, whereas 11% never returned for surveillance after initial hospitalization. Follow-up was compared for each of the comorbidities and socioeconomic factors; none were found to significantly affect follow-up. The known complication rate was 9.3% (n = 19), with reintervention performed in 14% of endovascular aneurysm repair/TEVAR patients. 38% of medically managed patients with type B dissections eventually required surgical intervention. All-cause 5-year mortality was 27% as determined by the Social Security Death Index.	4
74. Oliveira N, Bastos Gonçalves F, Ten Raas S, et al. Do we need long-term follow-up after EVAR and TEVAR or can we simplify surveillance protocols? <i>The Journal of Cardiovascular Surgery.</i> 2014;55(2 Suppl 1):151-158.	Review/Other-Tx	N/A	To describe the recommended surveillance strategies after endovascular aneurysm repair and TEVAR, determine the expected complication rate in modern series and to revise the data of risk-adapted surveillance strategies suggested in literature.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
75. Ganapathi AM, Andersen ND, Hanna JM, Gaca JG, McCann RL, Hughes GC. Comparison of attachment site endoleak rates in Dacron versus native aorta landing zones after thoracic endovascular aortic repair. <i>J Vasc Surg.</i> 2014;59(4):921-929.	Observational-Tx	697 landing zones	To compare the rate of type I endoleak occurring in Dacron landing zones vs native aorta landing zones using a large, single-institution TEVAR database that contains a high proportion of complex hybrid reconstructions involving endograft landing zones in segments of previously reconstructed Dacron aorta.	Identified were 697 proximal or distal landing zones (native aorta, 599; Dacron, 79; and endograft, 19). Patients with at least 1 Dacron landing zone had higher rates of hypertension ($P<.01$), chronic obstructive pulmonary disease ($P=.04$), and prior aortic surgery ($P<.01$) and were more likely to have undergone complex hybrid repairs ($P<.01$). Cumulative type I endoleak rates were equivalent between the 3 types of landing zone (native aorta, 3.7%; Dacron, 2.5%; endograft, 0%; $P=.44$). Two type I endoleaks occurred with Dacron landing zones in the first tertile of TEVAR experience and with Dacron landing zone lengths of <2.5 cm. Evaluation of endoleak rates by tertile of experience demonstrated decreased type I endoleak rates in Dacron landing zones between the first and second/third tertiles of experience (13.3% vs 0%, $P=.03$) after a policy of using >4 to 5 cm (twice the device instructions for use) of Dacron overlap was initiated.	2
76. Ozdemir BA, Chung R, Benson RA, et al. Embolisation of type 2 endoleaks after endovascular aneurysm repair. <i>J Cardiovasc Surg (Torino).</i> 2013;54(4):485-490.	Review/Other-Tx	N/A	To give an overview of type II endoleaks, their natural history and vessels most commonly involved, as well as different approaches to embolization.	No results stated in abstract.	4
77. Patterson BO, Vidal-Diez A, Karthikesalingam A, Holt PJ, Loftus IM, Thompson MM. Comparison of aortic diameter and area after endovascular treatment of aortic dissection. <i>Ann Thorac Surg.</i> 2015;99(1):95-102.	Observational-Tx	100 patients	To determine if aortic diameter measurements could be used to approximate aortic area in order to refine reporting standards.	Aortic true and false lumen diameter and area showed good correlation ($P<0.001$) in the majority of anatomic locations. This relationship was present preoperatively and during follow-up ($P<0.001$). The linear regression models fit well with high R(2) values. At very large aortic sizes nonlinear models were a slightly better fit, but this was not significant.	1
78. Hughes GC, Andersen ND, McCann RL. Management of acute type B aortic dissection. <i>J Thorac Cardiovasc Surg.</i> 2013;145(3 Suppl):S202-207.	Review/Other-Tx	N/A	To discuss the management of acute type B aortic dissection and long-term treatment considerations.	No results stated in abstract.	4

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
79. Tsai MT, Wu HY, Roan JN, et al. Effect of false lumen partial thrombosis on repaired acute type A aortic dissection. <i>J Thorac Cardiovasc Surg.</i> 2014;148(5):2140-2146 e2143.	Observational-Tx	67 patients	To investigate the effects of a partially thrombosed false lumen on the segmental growth rates, distal aortic reoperations, and long-term survival.	The segmental aortic growth rate of completely thrombosed, completely patent, and partially thrombosed false lumens was -0.10+/-0.31, 0.09+/-0.22, and 0.35+/-0.60 mm/mo at the proximal descending thoracic aorta ($P=.001$), -0.04+/-0.18, 0.12+/-0.19, and 0.28+/-0.28 mm/mo at the middle descending thoracic aorta ($P<.001$), and -0.02+/-0.13, 0.07+/-0.07, and 0.16+/-0.14 mm/mo at the distal descending thoracic aorta ($P<.001$), respectively. The corresponding freedom from reoperation rates for the proximal descending thoracic aorta at 10 years were 100%, 88%, and 62% ($P=.013$). The overall 10-year survival rate was 89% and was not significantly different among the study groups.	2
80. Eriksson MO, Steuer J, Wanhainen A, Thelin S, Eriksson LG, Nyman R. Morphologic outcome after endovascular treatment of complicated type B aortic dissection. <i>J Vasc Interv Radiol.</i> 2013;24(12):1826-1833.	Observational-Tx	51 patients	To investigate the long-term morphologic changes of the aorta after TEVAR for acute complicated type B aortic dissection and to analyze whether these changes differed between DeBakey class IIIa and IIIb dissections.	There was an overall significant reduction of the thoracic aortic diameter, increased true lumen diameter, and reduced false lumen diameter ($P<.05$). Total thrombosis of the false lumen, with or without reintervention, was seen in 53% of all patients, in 41% primarily and in 12% after reintervention. The IIIa group had a higher degree of total false lumen thrombosis. All patients in the IIIb group had total thrombosis of the false lumen along the stent graft.	2

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
81. Song SW, Kim TH, Lim SH, Lee KH, Yoo KJ, Cho BK. Prognostic factors for aorta remodeling after thoracic endovascular aortic repair of complicated chronic DeBakey IIIb aneurysms. <i>J Thorac Cardiovasc Surg.</i> 2014;148(3):925-932, 933 e921; discussion 932-923.	Observational-Tx	20 patients	To analyze the potential prognostic factors affecting aorta remodeling after TEVAR for chronic DeBakery III type b aneurysms.	All the patients had uneventful in-hospital courses; 2 patients (10%) required reintervention during the follow-up period. 13 patients (65%) had complete thrombosis of the false lumen at stent graft segment. Compared with the complete thrombosis group, the partial thrombosis group had more reentry tears (1.8 vs 2.3, $P=.48$), large intimal tears (0.8 vs 1.7, $P<.05$), visceral branches arising from the false lumen (1.2 vs 2.3, $P<.05$), and intercostal arteries arising from the false lumen (3.8 vs 5.1, $P=.35$). Reentry tears, visceral branches, and intercostal arteries from the false lumen were significant negative prognostic factors for false lumen shrinkage ($P<.05$).	2
82. Sueyoshi E, Nagayama H, Hashizume K, Eishi K, Sakamoto I, Uetani M. Computed tomography evaluation of aortic remodeling after endovascular treatment for complicated ulcer-like projection in patients with type B aortic intramural hematoma. <i>J Vasc Surg.</i> 2014;59(3):693-699.	Observational-Tx	18 patients	To investigate changes of the affected aorta after endovascular treatment for complicated ulcer-like projection, including aneurysmal change or rupture of ulcer-like projection, or both, in patients with type B aortic IMH.	A stent graft was successfully deployed and ulcer-like projections disappeared in all patients. IMH disappeared in 16 or decreased in 2 after treatment. There were significant differences in the mean maximum aortic diameter (37.8 +/- 5.2 vs 34.5 +/- 5.2 mm; $P=.0006$), mean IMH volume (39.4 +/- 12.1 vs 2.0 +/- 6.0 mL; $P<.0001$), and total volume of the aorta with IMH (158.1 +/- 40.2 vs 128.9 +/- 28.0 mL; $P<.0001$) before and after treatment.	2

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
<p>83. Murphy EH, Szeto WY, Herdrich BJ, et al. The management of endograft infections following endovascular thoracic and abdominal aneurysm repair. <i>J Vasc Surg.</i> 2013;58(5):1179-1185.</p>	<p>Observational-Tx</p>	<p>18 patients</p>	<p>To examine the results of treatment at a single center for the management of infected aortic endografts.</p>	<p>Overall, 18 patients were treated for infected endografts (thoracic: 6, abdominal: 12). 3 patients were treated between 2000 and 2006, corresponding to a 0.6% institutional incidence of endograft infection (3/473). There were no transfers for infected endografts from outside institutions. From 2006 to 2011, 15 patients underwent treatment. 6 were institutional cases of infections (6/945, 0.6% infection rate), however, there was an increase in transfers (n = 9). Median time to presentation with infection from endograft implant was 90 days, with over one-half (61%) presenting within the first 3 months. Tissue and/or blood cultures were positive in 12/16 growing <i>Escherichia coli</i> (n = 1), group A streptococcus (n = 3), methicillin-resistant <i>Staphylococcus aureus</i> (n = 3), or polymicrobial infections (n = 7). The other 4 patients were culture negative with CT evidence of gas surrounding the endograft and clinical sepsis. 10 patients (abdominal: 8, thoracic: 2) were treated with endograft explantation. The remaining 8 patients were considered too high-risk for explant or refused open surgery and were therefore managed conservatively without explant (abdominal: 4, thoracic: 4). At a mean follow-up of 24.7 months, aneurysm-related mortality was 38.9% (n = 7) and was higher for patients presenting with aortoenteric or aortobronchial fistulas (n = 6/10, 60%) (P=.04) and for thoracic stent infections (n = 5/6; 83%) (P=.03). The only survivor of a thoracic infection was managed surgically. Overall survival for patients with abdominal endografts (n = 12) was similar between the 8 patients managed surgically (n = 6/8; 75%) and the 4 selected for medical management (n = 4/4; 100%) (P=.39). All survivors remain on long-term suppressive antibiotics. 2 additional patients died of unrelated causes during follow-up.</p>	<p>2</p>

* See Last Page for Key

**Thoracic Aorta Interventional Planning and Follow-Up
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
84. Zoli S, Trabattoni P, Dainese L, et al. Cumulative radiation exposure during thoracic endovascular aneurysm repair and subsequent follow-up. <i>Eur J Cardiothorac Surg.</i> 2012;42(2):254-259; discussion 259-260.	Observational-Tx	48 patients	To investigate cumulative radiation exposure of patients undergoing TEVAR—including the preoperative workup, the procedure and recurrent follow-up CT imaging	The average screening time was 15.7 +/- 11.4 min, with a radiation exposure of 11.3 +/- 9 mSv. Obese patients had significantly higher radiation exposure during TEVAR (Pearson's coefficient = 0.388, $P=0.019$). The radiation exposure dropped from 14.9 +/- 9.4 mSv to 8.6 +/- 7.9 mSv ($P=0.033$) after a hybrid suite was established. Our institutional TEVAR protocol involves 1 preoperative thoracoabdominal CT scan and 3 follow-up thoracic CT scans for the first year, with a yearly evaluation thereafter. The life expectancy of an age- and sex-matched population was 17 years. A patient adhering to our surveillance protocol would be subjected to an overall exposure of 89 mSv at 1 year and 161 mSv at 5 years, with a projected lifetime radiation exposure >350 mSv.	2
85. Deak Z, Grimm JM, Mueck F, et al. Endoleak and in-stent thrombus detection with CT angiography in a thoracic aortic aneurysm phantom at different tube energies using filtered back projection and iterative algorithms. <i>Radiology.</i> 2014;271(2):574-584.	Observational-Dx	N/A	To determine the lower limit of dose reduction with hybrid and fully iterative reconstruction algorithms in detection of endoleaks and in-stent thrombus of thoracic aorta with CTA by applying protocols with different tube energies and automated tube current modulation.	Both sensitivity and specificity were 100% for simulated lesions on images with 2.5-mm section thickness and a noise index of 25 (3.45 mGy), 34 (1.83 mGy), or 43 (1.16 mGy) at 120 kVp; a noise index of 34 (1.98 mGy), 43 (1.23 mGy), or 61 (0.61 mGy) at 100 kVp; and a noise index of 43 (1.46 mGy) or 70 (0.54 mGy) at 80 kVp. Signal-to-noise ratio values showed similar results. With the fully iterative algorithm, mean attenuation of the aorta decreased significantly in reduced-dose protocols in comparison with control protocols at 100 kVp (311 HU at 16 noise index vs 290 HU at 70 noise index, $P\leq.0011$) and 80 kVp (400 HU at 16 noise index vs 369 HU at 70 noise index, $P\leq.0007$).	1

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
86. Bley TA, Chase PJ, Reeder SB, et al. Endovascular abdominal aortic aneurysm repair: nonenhanced volumetric CT for follow-up. <i>Radiology</i> . 2009;253(1):253-262.	Observational-Dx	70 patients	To retrospectively evaluate the clinical usefulness of volumetric analysis at nonenhanced CT as the sole method with which to follow-up EVAR and to identify endoleaks causing more than 2% volumetric increase from the previous volume determination.	Types I and III high-pressure endoleaks (n=10) showed a 10.0% (95% CI: 5.0%, 18.2%) interval volumetric increase. Type II low-pressure endoleaks (n=37) showed a 5.4% (95% CI: 4.6%, 6.2%) interval volumetric increase. Endoleaks associated with minimal aortic volume increase of <2% did not require any intervention. This protocol reduced radiation exposure by approximately 57%–82% in an average-sized patient. Serial volumetric analysis of aortic aneurysm with nonenhanced CT serves as an adequate screening test for endoleak, causing volumetric increase of more than 2% from the volume seen at the previous examination.	3
87. Cao P, De Rango P, Verzini F, Parlani G. Endoleak after endovascular aortic repair: classification, diagnosis and management following endovascular thoracic and abdominal aortic repair. <i>J Cardiovasc Surg (Torino)</i> . 2010;51(1):53-69.	Review/Other-Tx	N/A	To discuss endoleak after endovascular aortic repair: classification, diagnosis and management following endovascular thoracic and abdominal aortic repair.	No results stated in abstract.	4
88. Weigel S, Tombach B, Maintz D, et al. Thoracic aortic stent graft: comparison of contrast-enhanced MR angiography and CT angiography in the follow-up: initial results. <i>Eur Radiol</i> . 2003;13(7):1628-1634.	Observational-Dx	11 patients	To compare contrast-enhanced MRA and multislice CTA in the follow-up of thoracic stent-graft placement.	The contrast-enhanced MRA and multislice CTA were performed following nitinol stent-graft treatment due to thoracic aneurysm (n=4), intramural bleeding (n=2) and type-B aortic dissection (n=5). Corresponding evaluation of arterial-phase imaging characteristics focused on the stent-graft morphology and leakage assessment. Stent-graft and aneurysm extensions were comparable between both techniques. Complete exclusion (aneurysm, n=4; dissection, n=2) was assessed with high confidence with contrast-enhanced MRA and multislice CTA. Incomplete exclusion (intramural bleeding, n=2; dissection, n=3) was assigned to lower confidence scores on contrast-enhanced MRA compared with multislice CTA. On contrast-enhanced MRA the stent-graft lumen demonstrated an inhomogeneous signal; the stent struts could not be assessed.	3

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
89. Rasche V, Oberhuber A, Trumpp S, et al. MRI assessment of thoracic stent grafts after emergency implantation in multi trauma patients: a feasibility study. <i>Eur Radiol.</i> 2011;21(7):1397-1405.	Observational-Dx	20 patients	To evaluate the feasibility of MRI for static and dynamic assessment of the deployment of thoracic aortic stent grafts after emergency implantation in trauma patients.	The stent graft geometry and motion over the cardiac cycle were assessable by MRI in all patients. Flow-mediated signal variations in areas of flow acceleration could be well visualized. No statistically significant differences in stent-graft diameters were observed between CT and MRI measurements.	3
90. Karanikola E, Dalainas I, Karaolanis G, Zografos G, Filis K. Duplex Ultrasound versus Computed Tomography for the Postoperative Follow-Up of Endovascular Abdominal Aortic Aneurysm Repair. Where Do We Stand Now? <i>Int J Angiol.</i> 2014;23(3):155-164.	Review/Other-Dx	35 articles	To review and evaluate the safety of color-duplex US as compared with CT, based on the current literature, for post- endovascular abdominal aortic aneurysm surveillance.	There was a substantial heterogeneity among the studies due to the following reasons: 1. The wide range of the number of patients enrolled in each study (20–561). 2. Variation in CT protocol (CT or CTA, arterial phase, biphasic or triple phase). 3. The interobserver reliability for the US imaging, which was not defined with the exception of 2 studies: (a) Zannetti et al in 2000, evaluated the interobserver agreement in endoleak detection (k analysis value ¼ 1) and in a type of endoleak (k ¼ 0. 7) in 50 random duplex examinations. (b) Lezzi et al in 2009, estimated that the interobserver agreement in all reading sessions of enhanced color-duplex US for endoleak detection was high (k analysis value 0.89). In 6 studies all the US examinations were conducted by 1 single vascular sonographer. Color-duplex US or enhanced color-duplex US were performed by experienced vascular technologists in 18 trials. There is no information reported about the color-duplex US/enhanced color-duplex US operators for the rest 11 studies. Moreover, differences in US equipment quality, particularly in the earlier studies with less advanced US instruments, have not been evaluated.	4

**Thoracic Aorta Interventional Planning and Follow-Up
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
91. Nakai M, Sato H, Sato M, et al. Utility of (99m)Tc-human serum albumin diethylenetriamine pentaacetic acid SPECT for evaluating endoleak after endovascular abdominal aortic aneurysm repair. <i>AJR Am J Roentgenol.</i> 2015;204(1):189-196.	Observational-Dx	15 patients	To assess the utility of (99m)Tc-HSAD SPECT in the detection of endoleaks after endovascular abdominal aortic aneurysm repair.	Endoleaks were interpreted as perigraft radioisotope accumulation in 12 patients (80.0%) on (99m)Tc-HSAD SPECT images, in 13 patients (86.7%) on three-phase CT images, and in 15 patients (100%) on CT during aortography. The mean endoleak volume visualized with (99m)Tc-HSAD SPECT was 8.37 cm(3) (range, 5.2-15.1 cm(3)), and the volume not visualized was 3.47 cm(3) (2.5-4.6 cm(3)), a statistically significant difference ($P=0.019$). In 2 patients, (99m)Tc-HSAD SPECT depicted endoleaks evident at delayed phase CT during aortography but not at three-phase CT, suggesting they were slow-filling endoleaks. Accumulation of (99m)Tc-HSAD corresponding to endoleaks disappeared after embolization, but CT evaluation of embolization was impeded by artifacts of NBCA-Lipiodol and metallic coils.	3
92. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: http://www.acr.org/~media/ACR/Documents/AppCriteria/RadiationDoseAssessmentIntro.pdf . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document on exposure of patients to ionizing radiation.	N/A	4

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

AAS = Acute aortic syndromes

BAV = Bicuspid aortic valve

CI = Confidence interval

CT = Computed tomography

CTA = Computed tomographic angiography

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

IMH = Intramural hematoma

MRA = Magnetic resonance angiography

MRI = Magnetic resonance imaging

NPV = Negative predictive value

OR = Odds ratio

PPV = Positive predictive value

SPECT = Single-photon-emission computed tomography

SUV = Standardized uptake value

TEVAR = Thoracic endovascular aortic repair

US = Ultrasound