This is the second year for the new venue for ISET. The convention center worked out well, with large rooms and an adjacent exhibit hall. The attendance was good- thought to be slightly higher than last year. The mixture of specialties (VS, IR, Cardiology) makes information sharing interesting. Some of the key presentations are detailed below.

**Deciding Between Open and Endovascular AAA Repair**  
*Dr. Watch*

Open repair is still quite necessary- The decision is generally based upon age, comorbidities, follow-up protocol, and anatomical criteria. Case presentations were made as examples of these decisions. One interesting one regarding follow-up was a homeless man treated by open repair since he could get all of his post implantation surveillance done in the initial hospitalization.

MCVI has done 21 open repairs over the last 24 months. The most common indication is difficult neck anatomy and pararenal location.

**What's New in EVAR Technologies?**  
*Dr. Benenati*

This was a (fairly) unbiased overview of current devices and a look into the future. New devices are necessary because 64% of AAA in US, and 40% in Europe are being treated with EVAR (Why not all?). Devices used outside the IFU are more likely to fail or require secondary procedures. An estimated 30% of patients with AAA have an unsuitable neck. The Gore C3 repositionable was touted, then the decreased profile of newer devices, leading to the INCRAFT. Ovation was discussed along these lines as well. The Aorfix was presented for the highly angled necks, but admitted to not being used much. Aptus Endostaples were shown to “make migration nearly impossible”.

Moving to short neck/no neck cases, hybrid repair, branched/fenestrated repair, and parallel grafts were detailed. Dr. Benenati closed with EVAS (Nellix) stating that it virtually eliminates endoleaks and could change the way aneurysms are treated.

**EVAR in Complex Proximal Necks Presentation**  
*Dr. Eagleton*

Can we place endografts in complex necks? A: Yes, we’ve already been doing it. What is a “healthy enough” neck? A: One that provides a long term durable repair. Immediate technical success is certainly achievable. Hobo published in JEVTH 2007, the EUROSTAR results of AAA repair in neck
angulation, and at only 20 month follow up, the high angle group had a higher incidence of neck dilatation, new type I endoleak, and need for secondary intervention. This was not dependent on graft type (Excluder, Talent, Zenith). Short necks also performed worse at 30 days for systemic complications and death in EUROSTAR but there was no difference in death or conversion to open at 16 month follow up.

Newer technology shows potential for improved outcomes. Nellix and Ovation are promising, but not enough information to assess long term success.

The latest ENGAGE registry data was shown. There are 1900 patients enrolled. Early technical success impacted by Calcium/thrombus, not impacted by neck length or angulation.

This is not a device issue- this is a judgment issue. Aortas dilate with time- even normal ones. If the graft is placed in an already compromised neck, the probability of failure is increased.

**Preserving Renal Arteries: Chimneys Versus Fenestrated Grafts**

Dr. Makaroun

There is plenty of evidence showing superior results with endovascular repair over open- even in challenging anatomy. The presentation detailed fenestrated and chimneys with their pros and cons. FEVAR has good results in good anatomy- BUT it is not without problems. Inability to cannulate visceral vessels can require bypass, type I endoleaks, type III endoleaks, and misaligned fenestrations are a few more potential difficulties.

The attraction of parallel grafts include: lower profile, cheaper, off-the-shelf, and easier to perform.

<table>
<thead>
<tr>
<th>Fenestrated</th>
<th>Chimneys</th>
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<tbody>
<tr>
<td>Procedural details established</td>
<td>Variable techniques</td>
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<tr>
<td>Large worldwide experience</td>
<td>Variable clinical scenarios</td>
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<td>Long term results available</td>
<td>No long term results</td>
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<td>Custom device (3-6 weeks)</td>
<td>Choice of components</td>
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<tr>
<td>Many exclusions</td>
<td>Fewer exclusions</td>
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<td>For elective cases unless IDE</td>
<td>Suitable for emergencies</td>
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<tr>
<td>In summary, all options have a role-</td>
<td>Elective cases with suitable anatomy: FEVAR</td>
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<td>Emergency poor FEVAR anatomy/ Poor surgical risk: Chimps</td>
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<td>Good risk patients with unsuitable anatomy: Open Repair</td>
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Extreme EVAR with Off-the-Shelf Devices  

Dr. Arko

It is estimated that approximately 75% of AAA repair is performed with a commercially available device. Even with the advancement of both device and procedure, there still exists a subset of patients that do not fall with the broadening scope of EVAR. Questions to be asked before a AAA procedure: Location of the pathology, type of pathology, number of vessels involved in the proximal landing zone/ distal landing zone, what is the expected outcome, what is an acceptable outcome, and can this be done with current devices?

With appropriate pre case planning, access to a variety of peripheral/aortic devices, excellent perioperative imaging and staffing, most EVAR patients can be treated in a safe and effective manner. Utilizing off-the-shelf technologies is a bridge to future technology designs. Each patient must be evaluated carefully to determine the appropriate “outcome”.

Chimneys, fenestrations or branched stent grafts: Making an appropriate choice  

Dr. Morgan

AAA unsuitable for conventional EVAR: Short necked infrarenal, juxtarenal AAA, suprarenal AAA, TAAA. What are the options?

Fenestrated: Paradigm shift from infrarenal endografts, provide secure fixation and improved seal, use suprarenal aorta as sealing zone. FEVAR requires planning and manufacturing, has considerable anatomic requirements, but has good outcomes.

Branched endografts: Developed to treat TAAA’s, and indicated when the upper abdominal aorta is aneurysmal at and above the visceral arteries. There are anatomic requirements for BEVAR as well. Dr. Morgan stated that branched cases are easier to perform that fenestrated.

Hybrid: Visceral and renal artery bypass (1-4 vessels) usually placed to common iliac artery/arteries. Insertion of conventional thoracic/abdominal endografts. This is a useful alternative to FEVAR/BEVAR. Has limited anatomic contraindications, and very little planning prior to procedure.

Chimney EVAR: Single/ multiple stents placed parallel to main endograft to extend seal zone, therefore maintaining side branch patency. There are technical considerations with this repair, it is possible to perform in emergency setting, and available off-the-shelf. Other benefits are: reduced complexity, difficult anatomy can be treated, and reduced costs. It does however, have limited long-term data, questionable patency of chimney grafts, and gutter endoleaks in 5-31% of patients.

Type B Dissection: Current Technical Approaches  

Dr. Dake
Current treatment is to stent over the primary entry tear. Multilayer stent was mentioned but immediately discounted. The PETTICOAT technique was discussed with a stent graft proximally and a distal bare stent- with this, the false lumen flow must be occluded. The Knickerbocker technique was detailed which uses a stent graft and balloon expansion with the intent of thoracic false lumen isolation. STABILIZE is the technique of a proximal graft, bare stent through the mesenteric area, and balloon expansion of distal graft and bare stent. Distal balloon fenestration of dissection septum is still a useful tool, as well as Septotomy using a guidewire or specialty cutter.

Some secondary interventions were discussed as well. Occlusion of the false lumen using Candy wrapper stent or coils/embolics was mentioned. The presentation turned to some case reports with successful exclusion of the dissection, and positive aortic remodeling.

**TEVAR Will Not Be Sufficient for Most of the Type B Aortic Dissections in the Long-Term**

Dr. Parodi

The actual title of Dr. Parodi’s presentation turned out to be: Early Septotomy MAY BE THE FUTURE OF MANY TYPE B AORTIC DISSECTION MANAGEMENT. Development of false lumen dilatation can be caused by many factors including: less resistance to dilation due to thinner walls, inflammation of the wall, degradation of the collagen and elastin by MMP’s, and persistent high pressure in the false lumen- mainly diastolic. We all know that partial false lumen thrombosis portends negative outcomes in dissection patients- the risk of death is increased by a factor of 2.7. Free flowing, or completely thrombosed both behave more favorably. Tear size, location of tear, and pressures in the true and false lumens also play a role in outcomes. Many of these symptoms can be mitigated by the performance of a Septotomy (which coincidentally, Dr. Parodi has developed). In the future, many, if not all, TBAD will be treated with TEVAR occluding the entry site. Septotomy could be needed in most of these cases as well.

**Strategies for the Management of Malperfusion Syndrome**

Dr. Morgan

30-50% of aortic dissections have some malperfusion. This increases the in-hospital mortality x3. There are two type of malperfusion- static and dynamic. Static occurs when the dissection flap extends into the vessel- and if there is no outflow for the false lumen, you get thrombosis. Dynamic malperfusion occurs when the true lumen is compressed by the false lumen- caused by a large primary entry tear and a small exit tear. The treatment options included TEVAR, TEVAR with bare stent extension, percutaneous fenestration, and TEVAR plus spot stenting.

**Management of Late TEVAR Failures**

Dr. Eskandari

Delayed failures of TEVAR include: Endoleaks, stent fracture, retrograde dissection, collapse and infection. In a single center review of secondary interventions in 83 TEVAR patients, age, fusiform morphology, and proximal seal zones <3.0 cm predicted the need for late re-intervention. In another
single center review of the significance of type II endoleak following TEVAR in 344 patients, there were 8.7% with a type II at 29 months. Re-intervention is recommended with type II and sac enlargement particularly in cases of the left subclavian artery. Most of the late failures are managed with endovascular therapy- with the exception of infection and retrograde dissection.

Late-Breaking Trial: Cerebral Embolic Protection in Thoracic Aortic Stentgrafting

Dr. Hamady

This is an interesting device- not unheard of, but shows promise for cerebral protection. Dr. Hamady began with some staggering published numbers of cerebral events following TEVAR (63% SCI in one study, 83% cerebral infarction and 68% SCI in another). The Sentinel Cerebral Embolic Protection System (SPCS) from Claret Medical in California is a deployable filter that covers the BC and LCCA. In a small subset of patients (4) included in their pilot study, it halved the rate of new lesions seen by DW MRI (2/4). All filters were sent for histopathologic study following the procedures and ALL had some type of debris- most often thrombus and arterial wall. A RCT is being planned to move forward.

Indications for Left Subclavian Artery Revascularization During TEVAR

Dr. Eskandari

The two techniques for LSA revascularization were detailed: Transposition and Bypass. Each has pros and cons. Existing LIMA-based coronary bypass is an absolute indication for LSA revasc. Some relative indications include: Reduce posterior stroke risk, reduce paraplegia risk, reduce arm ischemia risk, reduce subclavian steal risk, and reduce type Ia/II endoleaks. A review of all the literature available shows a neurological complication rate of 23% vs. 3% with LSA coverage vs. revasc. respectively. In the EUROSTAR database, there were 606 patients with thoracic dissections, 15 had post-op paraplegia/paraparesis, 19 had post-op stroke. Multivariate analysis showed LSA coverage without revasc. to be an independent risk factor for post-op spinal cord ischemia. The SVS guidelines suggest routine revasc. with emergent cases treated individually.

State-of-the-Art in Dissection Therapy

Dr. Dake

This was intended to be “part two” of Dr. Dake’s earlier presentation. There were multiple graphs and papers showing the results of medically managed dissections as well as endovascular repair of dissections and the outcomes of each. Basically, when comparing optimal medical therapy (OMT) and optimal medical therapy plus TEVAR, the all-cause mortality and the aortic related mortality initially favor OMT, but they then cross over each other, with all-cause crossing at approximately 36 months, and aortic crossing at 28 months to favor OMT plus TEVAR. Aneurysm degeneration, late aortic remodeling, and maximum aortic diameter all favor repair of the dissection rather than OMT. The DISSECT mnemonic we are all aware of was then presented and detailed.
Dr. Makaroun tends to give a very comprehensive review when discussing topics of controversy. The current treatment recommendation for uncomplicated, chronic type B dissection is medical management and an imaging protocol of 6 weeks and annually thereafter. From the European Heart Journal, TEVAR should be considered (Class IIa, level B).

An interesting point was made regarding the two approved devices: Although the IDE studies were limited to acute complicated patients, the FDA approved labeling for ALL dissections!! Post marketing studies were directed to a professional society data gathering mechanism: The VQI.

The evidence supporting TEVAR is very good, but if this is so, why not use it in uncomplicated patients? A: The evidence is mixed regarding the outcomes of medically managed dissections and TEVAR. Some reports show outstanding results for OMT. The INSTEAD-XL study as we all know showed similar results for uncomplicated chronic dissections through 2 years... BUT, remodeling was usually limited to the covered areas and after 2 years, OMT plus TEVAR had superior aortic related mortality with the curves widening through 6 years! There were many other proven benefits shown as well as the criticisms of the study (underpowered, large mean aortic size, retrospective long term f/u, unusual “landmark” analysis at 2 years).

The question of when to treat is still unanswered. The ADSORB trial indicates the early phase (<14 days), the MOTHER registry suggests the subacute phase (2-6 weeks) and the INSTEAD-XL trial suggests waiting until the late phase... or wait for an indication?

In conclusion, until more evidence is available, the main treatment for uncomplicated TBAD should remain OMT. Some poorly defined group of patients will benefit from early prophylactic TEVAR.

Endurant Endograft: Device Evolution and Five-Year Results

As one would expect, many of the slides presented came directly from Medtronic. The timeline of Endurant evolution was presented with the respective changes. The presentation focused on two studies: the US IDE, and the ENGAGE registry. The IDE enrolled 150 patients from 26 sites and has 5 year follow up. The results (as expected) were very good for lack of endoleak, low post implant rupture rates, 95.2% decreasing/stable aneurysm size at 5 years, and 99.2% rupture rate through 5 years (the one rupture patient refused treatment of a type Ia leak). The ENGAGE registry enrolled 1263 patients worldwide, shows real world/real practice experience and has 4 year follow up. These results presented were equally good: high intra-operative clinical success, high technical success, high freedom from intra-operative death, and high freedom from type I/III endoleak. 4 year freedom from all-cause mortality was 74.1% and freedom from AAA-related mortality was 98.3%. I’ll end the infomercial now.

Current Status of the INSPIRATION Trail: Is Small the Answer? Two-Year Results
Dr. Makaroun changed the title of this presentation stating that premarket promotion made the original title unfair (more like unlawful). Low profile Device Development: Potential Advantages and Disadvantages We started with Ancure and 27Fr OD, and now we are at 14Fr with Ovation and Incraft. Benefits of low profile include: Easier delivery, Navigates tortuosity, Usable in smaller calcified iliac vessels, Less iliac injuries, more applicable to women, makes more patients candidates for EVAR, and easier for percutaneous access. Case studies were shown with Incraft devices as well as Zenith Alpha Thoracic.

In a literature review to determine the potential impact of smaller devices, a report from 1998-1999 would have excluded 8.7% of patients by iliac disease. A 2006 report showed that iliac disease limited EVAR in 54% of patients during 1997-2000 and 42% of patients during 2000-2003- and it is still decreasing.

So, Is there a clinical need for lower profile devices? A: Yes, but in a limited number of patients.

Zenith LP was presented as a mostly new device still in trials in US. Good slide showing the potential benefits (nitinol, new capless configuration, new stent configuration, woven polyester, new dilator tip and cannula) and showed the diameter reduction from 18-22Fr down to 16Fr.

Is there a trade-off with low profiles? A: Probably yes. Lighter fabrics and stent gauge may decrease durability. However Advanced preclinical testing and Novel technology should mitigate any major problems.

Is there a point of diminishing returns? A: Probably yes. A size less than 14Fr is unlikely to increase applicability of EVAR, reduce complications further or simplify the procedure significantly.

Low profile devices are already here. EVAR devices over 20Fr are disappearing and devices 16-20Fr are undergoing changes to reduce their profiles. The biggest benefit will be seen in TEVAR devices.

**EVAS: Different but Transformational?**

Dr. Benenati

EVAS is a developing treatment strategy to: Seal the entire aneurysm, Treat a broad range of patients with a simple, consistent procedure, Directly address the sources of conventional stent graft failures, minimize endoleaks, prevent device migration, reduce occlusions, and decrease rates of reintervention. The Nellix device was described at length, with cases and deployment details. Potential benefits were listed as: Options for challenging anatomies, Decrease high rate of secondary interventions, and Decrease surveillance burden. At least 1 in 8 patients with EVAR will undergo a secondary intervention within 5 years. The Nellix outcomes were based on the Carpenter publication (JVS 2016), from their IDE pivotal trial- which of course had excellent results.

**The Role of Endografts in the Treatment of Aortic Trauma**

Dr. Dennis
The scope of the problem: Blunt thoracic aortic trauma is a life-threatening emergency- 15-20% of cases are fatal. Most (>80%) are from high speed MVC. 54-65% of the dissections are located at the proximal descending thoracic aorta (this is a relatively mobile vessel against a fixed ligamentum arteriosum). To further complicate the presentation, there are many associated injuries as well. Conventional treatment was early open repair with surgical graft interposition, but since first introduced in 1997 by Dr. Dake, endovascular aortic repair has become more and more prevalent. Both procedures have limitations, but several meta-analyses have shown superiority with endovascular repair. Timing of repair, sizing of the device, and other procedural considerations were discussed. The results of their single center study were also detailed.

In conclusion, Endovascular repair of acute thoracic aortic disruptions are well established as the gold-standard treatment. Technical considerations differ from aneurysms and dissections. Acceptable landing zones can be lengths <10mm with good results. In most cases only a single stent graft is required. These repairs seldom need early re-intervention. Long term durability remains a concern.

Staging of Endovascular Aneurysm Repair May Lower the Risk of Spinal Cord Ischemia  Dr. Eagleton

SCI is a devastating complication after aortic surgery. Much effort has been directed towards understanding: the pathophysiology of SCI development, strategies to prevent this complication, and strategies to treat it when it occurs. Simplified, the etiology of SCI is: Intercostal interruption (length of coverage), Collateral flow interruption (vertebrals, internal iliacs), Hypotension, Embolic, Management (hemodynamic support, CSF drainage). Some strategies to decrease SCI include: Neuroprotective measures and multiple attempts to maintain spinal cord perfusion. The data on staging repairs is limited... Perfusion branches with staged occlusion shows promise, staging the total endovascular repair is also a possibility. The hypothesis is that staging might mitigate the severity of SCI after extensive endovascular repair of TAAA. In small reports, the data supports staging- lower rates of SCI with two stage vs. single stage procedure (even if unintentionally staged).

The Cleveland Clinic experience with TEVAR for extensive TAAA disease suggests that intentional staging: 1) Protects against SCI- lower rates of development, less severe symptoms, and higher rates of recovery. 2) Enhances overall survival. There are many future questions to be answered.

Uncomplicated TYPE B Dissection: Early Treatment Is Warranted  Dr. Dake

Dr. Dake takes the podium once again to support a debate-style presentation on uncomplicated dissections. With dissection, there are some factors that are becoming known to achieve better results through patient selection: >40mm trans-aortic diameter at diagnosis, <22mm FL diameter at initial diagnosis, P1T <10mm; 12; 15mm, Partial FL thrombosis, FL diastolic BP > TL diastolic BP, and > 1 major abdominal branch with aortic FL flow contribution. Each of these factors was discussed with data points to support.
Uncomplicated Type B Dissection: Early Treatment Is Unwarranted

Dr. Eagleton pointed out first that Dr. Dake made all of the same points that he had planned to make (it was just a difference in point of view). The presentation immediately conceded that early treatment is warranted in many patients but not all. The IRAD registry initial assessment (from 13 years ago) showed an in-hospital mortality of 13%, the mortality of those requiring surgery was 32%, with 85% of the deaths occurring in the first week. The etiology of death was rupture in 70% of cases and visceral ischemia in 19%. When the IRAD data is broken into 6 groups ranked by dates ~3 years, the endovascular repair arm is steadily increasing- and all patients get optimal medical therapy. INSTEAD and ABSORB were discussed as from an earlier presentation. Not everyone benefits from TEVAR, and TEVAR is not benign (RTAD, Stroke, Paraplegia, etc.). Selective TEVAR is therefore warranted- not TEVAR for all. There are many more questions to be answered before one can dogmatically choose one approach over the other.