




1

- ▼ The actor George C. Scott, celebrated for his performance in the title role of the movie "Patton" and many other roles on the screen and stage, died on September 22, 1999.



- ▼ One news source stated: "...George C. Scott died of a **stomach hemorrhage**..."
- ▼ Scott had been warned by his doctor about the risk of rupturing a blood vessel in his stomach but delayed treatment."

2

Aortic Aneurysms

How Big is the Problem?

- ▼ 1 - 5 % of general population affected
 - Incidence is increasing
- ▼ AAA: 100,000 – 250,000 new cases each year in the U.S.
- ▼ TAA: approximately 15, 000 new cases each year
- ▼ 43,000 – 47,000 deaths per year (CDC)
 - Twice as many deaths from thoracic aortic dissection and rupture than abdominal

3

Aortic Aneurysms

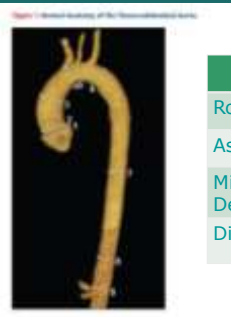
How Big is the Problem?

- ▼ 13th – 15th leading cause of death in the USA
- ▼ 2/3 of patients who suffer a ruptured aneurysm will die before even reaching the hospital.
- ▼ 90% mortality with ruptured AAA
- ▼ About 60% of deaths due to aortic aneurysm or aortic dissection happen among men.

Source: Society of Thoracic Surgeons & CDC

4

Normal Size of Aorta




Size in CM	
Root	3.5–3.91
Ascending	2.86
Mid Descending	2.39–2.64
Diaphragmatic	2.43-2.69

Source: J Vasc Surg 1991;13:452-8 and 2010 Guidelines TAD.

5

Aortic Aneurysm (AA)

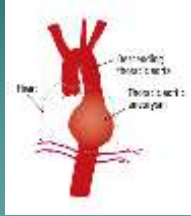


- ▼ Abnormal dilation of the aortic wall that alters the vessel shape and blood flow
 - 50% increase in the diameter of a vessel in comparison of it's expected normal
- ▼ With gradual enlargement, the aorta becomes increasingly weakened, leading to possible dissection and rupture.

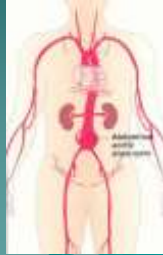
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Aortic Aneurysm (AA)

Thoracic
TAA

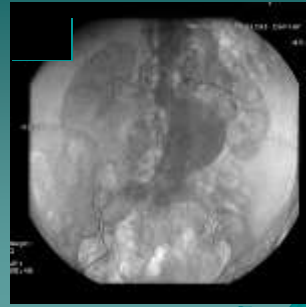


Abdominal
AAA



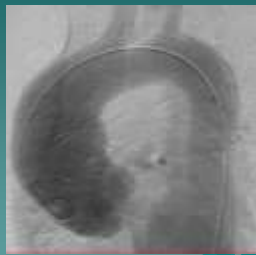
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Abdominal Aneurysm



8

Thoracic Type A Aneurysm



9

Risk Factors

- ▼ Hypertension
- ▼ Increasing Age
- ▼ Smoking
- ▼ Cocaine or other stimulant use
- ▼ Weight lifting or other valsalva maneuver
- ▼ Trauma
- ▼ Deceleration or torsional injury
- ▼ Family history
- ▼ Marfan's syndrome
- ▼ Loey's-Dietz Syndrome
- ▼ Turner Syndrome
- ▼ Pheochromocytoma
- ▼ Coarctation of the aorta
- ▼ Bicuspid valve

10

Smoking



- ▼ A history of smoking accounts for about 75% of all abdominal aortic aneurysms.
 - Current smokers are seven times more likely to develop AAA than non-smokers.
 - Former smokers are three times more likely.
 - The U.S. Preventive Services Task Force recommends that men 65 to 75 years old who have ever smoked should get an ultrasound screening for abdominal aortic aneurysms, even if they have no symptoms.
- ▼ Strongest modifiable risk factor for development of aneurysm.

11

Risk

- ▼ Aortic aneurysm disease is rare under the age of 50.
- ▼ Mean age of patient undergoing repair is 70.

12

Precipitating Events of onset of acute aortic dissection

- ▼ Extreme exertion
 - Weight lifters (Yale)
 - Extreme elevation in BP
- ▼ Episode of severe emotional upset

13

Aortic Aneurysm Rupture

- ▼ A tear in the vessel wall near or at the location of the ballooning of the weakened area of the aorta allowing blood to hemorrhage into the chest or peritoneal cavity
- ▼ Rupture carries a 90% mortality

14

Dissection

- ▼ Tear in the intimal layer of the aortic wall
- ▼ Blood passes into the aortic media through the tear separating the intima from the surround media and/or adventitia, creating a false channel within the aortic wall



15

Dissection

- ▼ Acute Dissection
 - Diagnosed within 14 days of the onset of symptoms
 - The risk of death is greatest during this acute period
- ▼ Chronic Dissection
 - Diagnosis after two weeks of the onset of symptoms

16

A Silent Disease

- ▼ 40% of individuals are asymptomatic at the time of diagnosis
 - Often discovered on a routine CXR or abdominal sonogram
- ▼ Only 5% of patients are symptomatic before an acute aortic event.
 - The other 95%, the first symptom is often death

17

AA Dissection Symptoms “The Great Imitator”

- ▼ S/S depend where the dissection occurs and what area is not getting oxygen
- ▼ Confused with:
 - Kidney stones
 - Gallstones
 - Paralysis -- think neuro diagnosis
 - Myocardial infarction

18

You suspect a dissecting/rupturing aneurysm....



Now What??

25

Rapid Triage & Treatments

- Aortic Center Aortic Pathway
Methodist Hospital Houston, TX



26

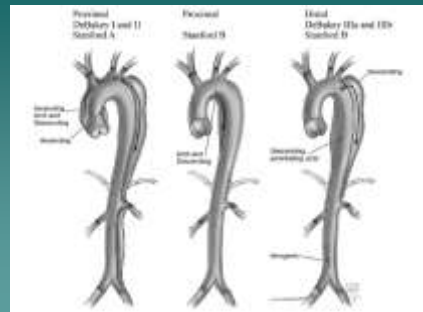
Diagnostics

- 12 Lead EKG to r/o STEMI
- Chest x-ray – not very helpful as no abnormalities noted
- CT scan



27

Aortic Dissection Classification: DeBakey and Stanford Classifications



Note: Figure 20 in full-text version of TAD Guidelines. Reprinted with permission from the Cleveland Clinic Foundation.

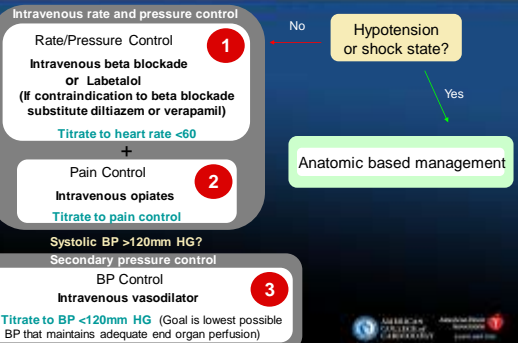
28

Dissections

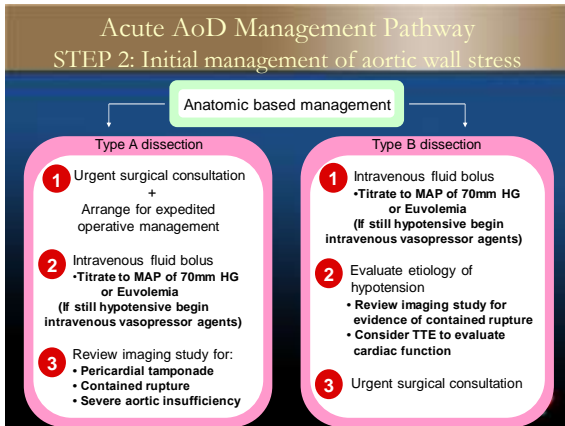
- 62% are Type A
- Type B are typically older than Type A
- Type A
 - Immediate operation room intervention
- Type B
 - Medical management

29

Acute AoD Management Pathway STEP 2: Initial management of aortic wall stress



30



31

Indications for AA repair

Thoracic

- ✓ Symptomatic
- ✓ Diameter 5.5 - 6 cm
- ✓ Diameter 4.4 - 5 cm associated with genetic disorder (Marfan's syndrome)
- ✓ Symptoms suggesting expansion or compression of surrounding structures

32

Indications for AA repair

Abdominal

- ✓ Diameter ≥ 5 cm
- ✓ Diameter ≤ 4 cm needs regular follow up
- ✓ Diameter 4 - 5 cm, management is controversial

33

Indications for AA repair


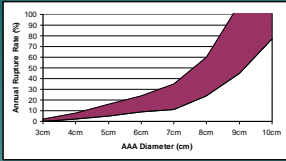
Both: TAA & AAA

- ✓ Rapidly expanding aneurysms
 - growth rate > 0.5 cm/year
- ✓ Symptomatic aneurysm regardless of size

34

Size --- It really does matter!

Annual Incidence of Rupture

- ✓ At 6 cm – aorta becomes a rigid tube
- ✓ It cannot stretch in systole
- ✓ Results in high wall stress
- ✓ 34% risk of rupture
 - TAA at 6 cm
 - AAA at 7 cm

35

Repair of AA

Traditional:



Open surgical repair

Evolving Trend:



Endoluminal grafting (ELG)

36

Surgical Repair for AAA

- ♥ > 50 years since first repair
- ♥ Average mortality 4%
- ♥ Significant short & long-term morbidity
- ♥ Causes of aneurysm related death well defined

37

Functional Outcome after Open Repair of Abdominal Aortic Aneurysm

Operative Mortality	4% (154 pts.)
Mean LOS	10.7 days
ICU LOS	4.6 days
Ambulatory Post-op	64% (25 mos.)
Decreased Functionality	33%
Time to Recovery	3.9 mos.
Unrecovered Again?	33%
	18% - No

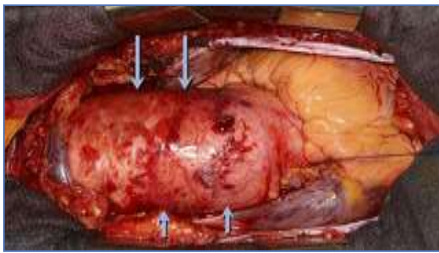
Williamson, et al - Portland, Oregon
J Vasc Surg 2001;33:913-20

38

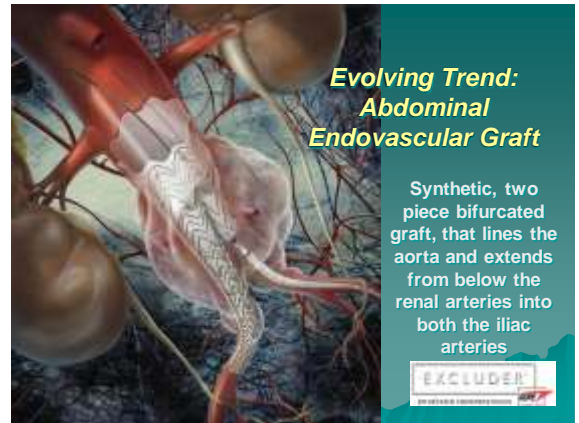
Thoracic Aneurysm

Natural History, Diagnosis, & Treatment Options

Thoracic Aortic Aneurysms - Resulting Dilatation



39

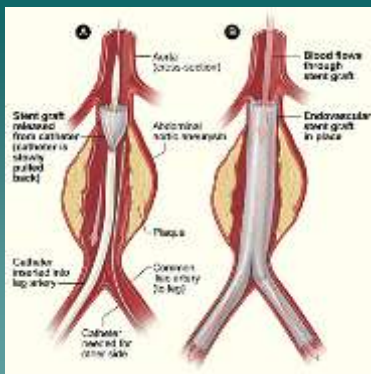


Evolving Trend: Abdominal Endovascular Graft

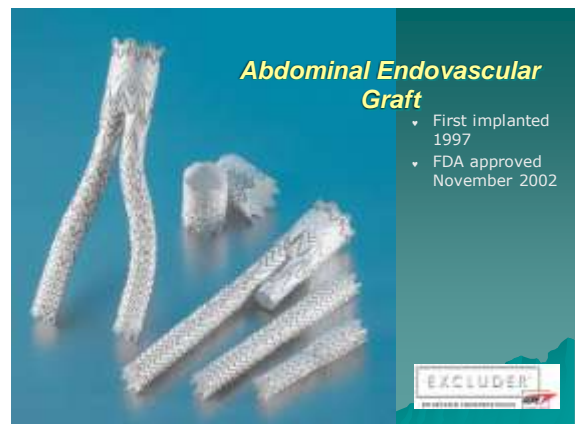
Synthetic, two piece bifurcated graft, that lines the aorta and extends from below the renal arteries into both the iliac arteries



40



41



Abdominal Endovascular Graft

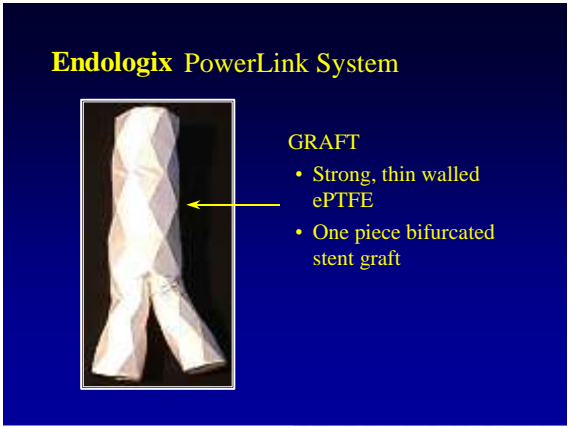
- ♥ First implanted 1997
- ♥ FDA approved November 2002



42



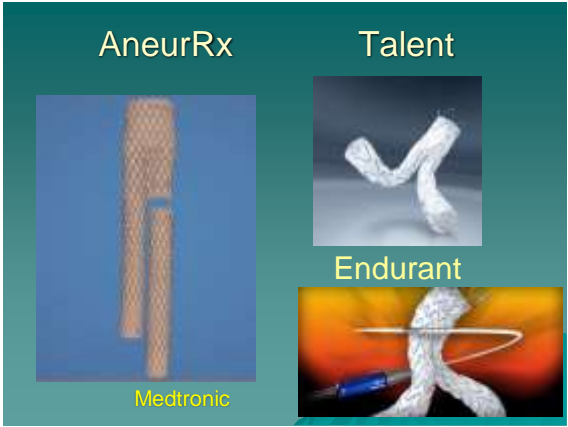
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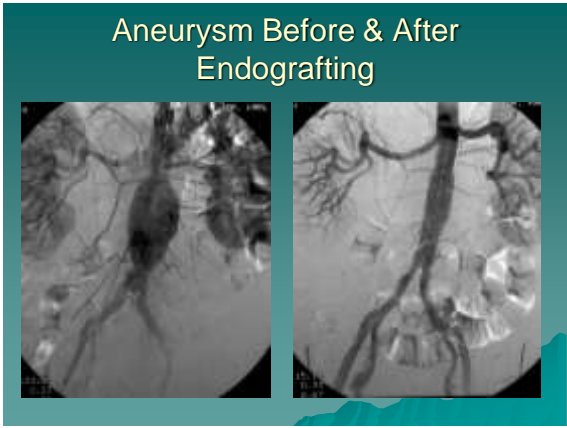
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48

TAG Thoracic Endograft

TEVAR: Thoracic Endovascular Aneurysm Repair

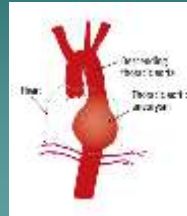
INDICATIONS:
Thoracic Aneurysms
Acute and Chronic Thoracic Dissection



49

TEVAR

Thoracic
TAA

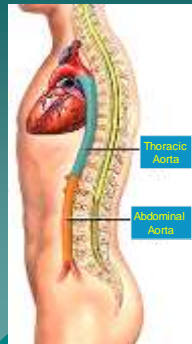
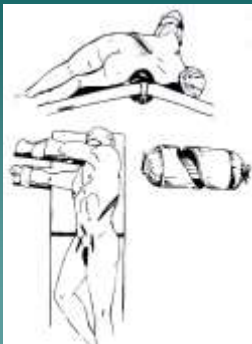


2003
Starting treating TAA
with endografts in
Peoria

2005 FDA approved

50

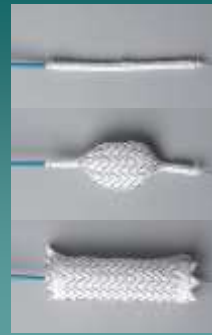
Morbidity of Open Repair



51

Gore TAG

*Deploys from the middle to the end
This prevents windsock
Windsock can move graft 3 - 5 cm*



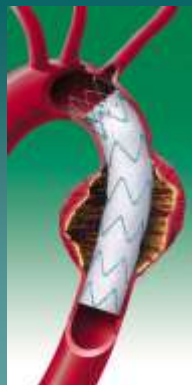
Approved by the FDA on March 23, 2005.



52

Medtronic Talent Stent Graft

Push pull method to open
Can migrate during cardiac
cycle while deploying.
Use Adenosine to stop heart
while deploying.
Deploys proximal to distal



53

Zenith[®] TX2[®]
TAA ENDOVASCULAR GRAFT



Transcend: Control
Achieve controlled proximal sealability and apposition.



54

Definition of Hybrid

An offspring resulting from cross-breeding



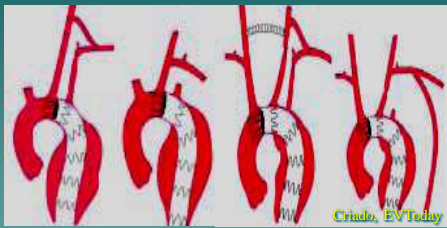
55

Hybrid Open/Endovascular Aneurysm Repair

- Hybrid approach: combines standard operative approaches and endografts and/or conduit creation/de-branching
- De-branching: the transposition of the origin of critical branch vessels to facilitate a seal zone

56

Aortic Debranching Extra-anatomical Bypass



- Aortic Debranching: The transposition of the origin of the critical branch vessels to facilitate a seal zone.
- Aortic Debranching is used to provide blood flow around the arch arteries that become occluded when a TAG is placed in the ascending aorta.

57

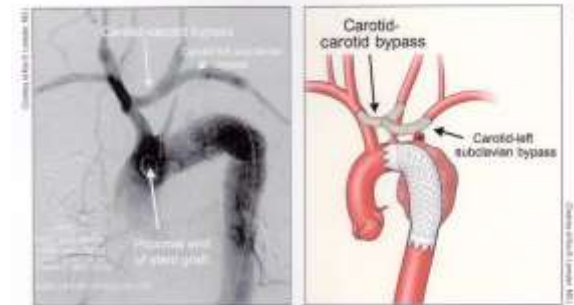
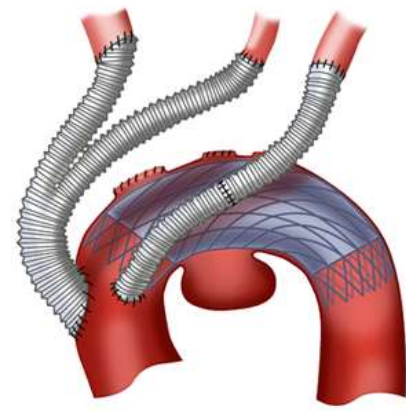


Figure 4. Hybrid repair involving a carotid-carotid bypass and a carotid-LSA bypass followed by endovascular placement of a stent graft.

Figure 5. Diagram depicting carotid-carotid and carotid-LSA bypasses.

58



59

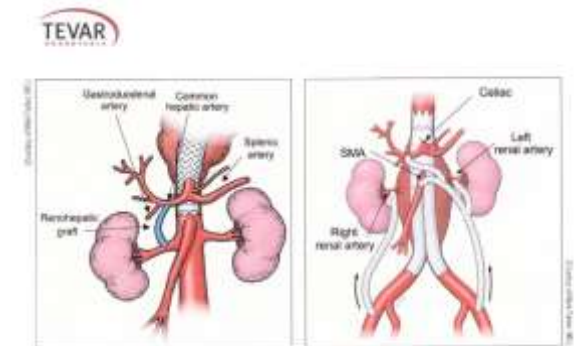
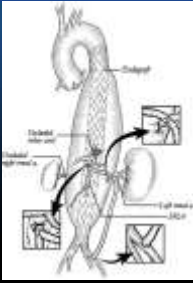


Figure 1. Diagram depicting hybrid thoracic repair involving revascularization bypass and coverage of the aortic arch.

Figure 2. Diagram depicting total visceral revascularization.

60

Hybrid Open Visceral Revascularization and Endograft Aneurysm Exclusion



Schema of TAA treated with initial left iliac artery-to-left renal artery-to-superior mesenteric artery bypass graft and subsequent placement of a thoracoabdominal endograft.

Proximal superior mesenteric artery and left renal arteries were ligated.

SMA indicates superior mesenteric artery; and TAA, thoracoabdominal aneurysm.

SOURCE: Adapted from Flye, et al. *J Vasc Surg*. 2004;39:454-8.



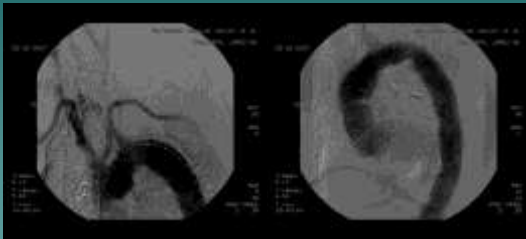
61

Photos courtesy of Dr James Bertram Williams

- A board-certified cardiothoracic and vascular surgeon Peoria, IL
- Principal investigator in a number of U.S. clinical device trials for endovascular devices.
- Endovascular Therapies Fellowship Training (ETFT) Program, a six-week visiting fellowship program www.etft.org

62

TAG inserted covering the subclavian artery.

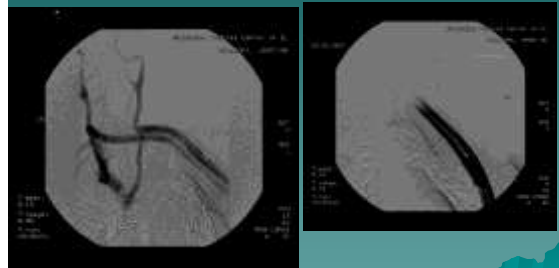


Pre TAG

Post TAG

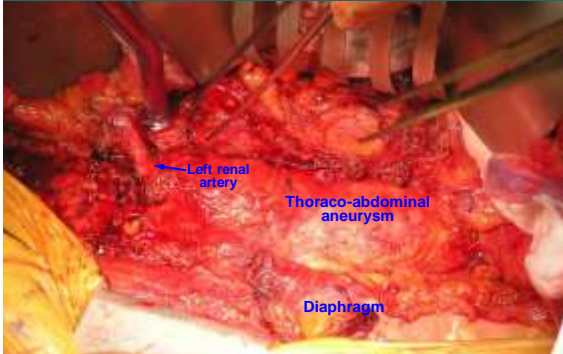
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Aorto bi-carotid bypass:
Y graft to the left & right common carotids
and the infrarenal abdominal aorta



64

Open Thoraco-Abdominal Aneurysm Resection

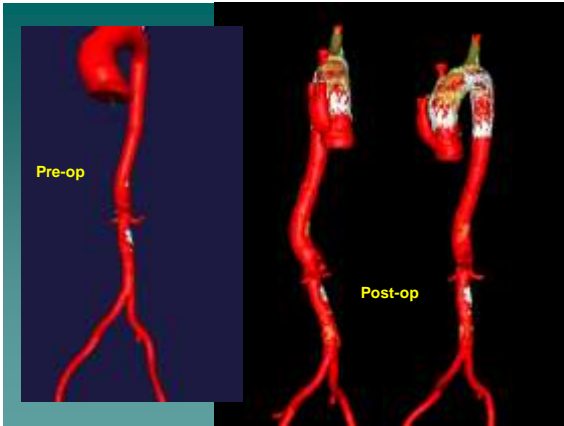


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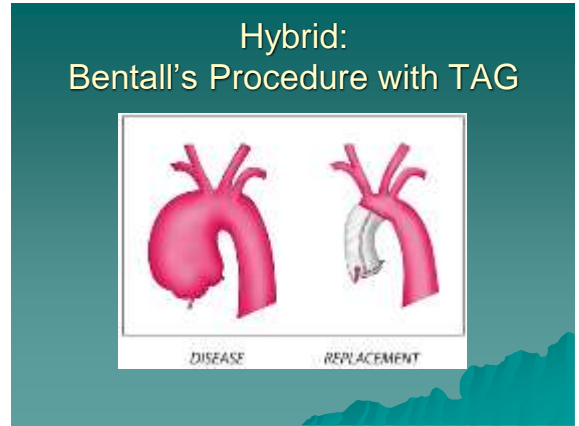
Aortic Arch De-Branching



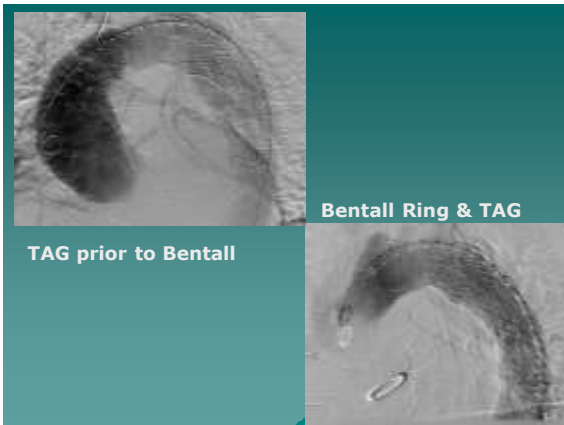
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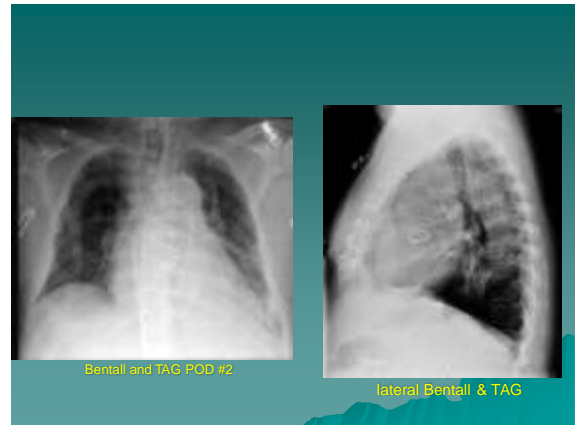
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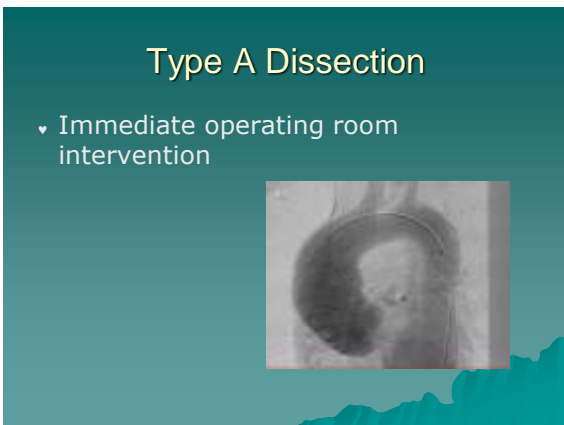
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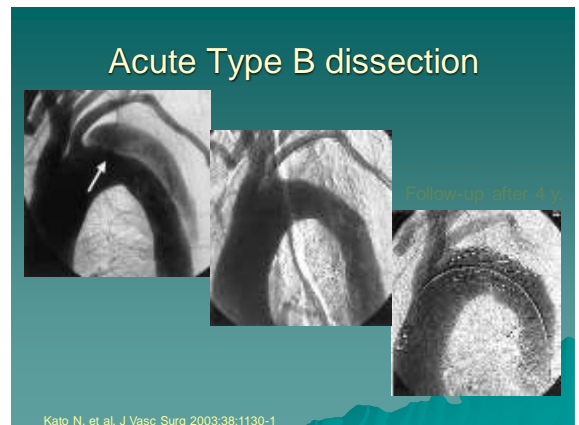
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71



72



73

Acute Type B Complicated Dissection

- ▼ Goal is to have the true lumen re-expand and the false lumen to resolve
- ▼ Need to understand anatomy of the dissection to know what the true lumen vs false lumen is feeding
- ▼ Prefer to wait 8 - 9 days to treat as will have less complications
- ▼ If repair 3- 5 days after dissection → significant re - dissection
- ▼ If wait longer than 9 days, then the true lumen may not re-expand

74

Acute Type B Dissection



75

Chronic Type B Dissection



76



77

Acute, Uncomplicated Type B Dissections

- ▼ Medical management is currently the most appropriate treatment
- ▼ Acute < 14 days

78

Medical Management Goals

- ▼ Lower systolic blood pressure to the lowest level commensurate with adequate vital organ perfusion, usually 100 to 120 mm Hg
- ▼ Lower heart rate to < 60 bpm
 - Tight heart rate control of 60 bpm improves the outcome of medical treatment in patients with aortic dissection

79



Initial management of thoracic aortic dissection <small>AHA/ACC guidelines 2010</small>	Class	Evidence
Intravenous beta-blockade should be initiated and titrated to a target heart rate of <60 bpm	I	C
Non-dihydropyridine calcium channel blocking agents as an alternative for rate control	I	C
If systolic BP remains >120 mmHg after adequate heart rate control, angiotensin-converting enzyme inhibitors and/or other vasodilators should be administered to further reduce BP that maintains adequate end-organ perfusion	I	C
Beta-blockers should be used cautiously with aortic regurgitation because they will block compensatory tachycardia	I	C
Vasodilator therapy should not be initiated prior to rate control to avoid associated reflex tachycardia	III	C

Reference: Suzuki T, et al. Medical management. In type B aortic dissection. *Ann Cardiothorac Surg.* 2014;3(4):413-417.

80

Beta-Blockers



Initial Treatment IV

- Propranolol
- Metoprolol tartrate
- Labetalol
- Esmolol
- Lower BP and HR

Effect

- Beta blockers reduce the inotropic state of the heart, decreasing left ventricular contractility and shear stress, and the impact force of ejected blood on the aorta
- BB do not lower diastolic BP as much, thus producing smaller pulse pressure
- Do not want a big pulse pressure as it causes more pounding on aorta

81

Non-Dihydropyridine Calcium Channel Antagonists

Non-Dihydropyridine CCB

- In patients who are unable to tolerate beta-blockade
- Verapamil
- Diltiazem

Effect

- Act selectively on the myocardium
- Reduce oxygen demand of myocardial tissue
- Minimal systemic effect and are less likely to cause reflex tachycardia
- Use of beta-blockers, verapamil or diltiazem for rate control in patients with significant aortic regurgitation is not recommended due to deleterious effects on reflex tachycardia

Dihydropyridine: Amlodipine and Nifedipine (-dipine)

- Act through systemic vascular vasodilation of arteries
- Can cause hypotension and cause reflex tachycardia
- Not recommended for Aortic Dissection

82

Vasodilators

Vasodilator

- Use to control blood pressure in addition to beta-blockade
- Nitroprusside IV
 - Rapidly titratable
 - Recommended as 1st choice
- Nicardipine, nitroglycerin and fenoldopam
 - Recommended 2nd choice

Effect

- Vasodilator therapy without prior betablockade may cause:
 - Reflex tachycardia and increased force of ventricular contraction
 - Leading to greater aortic wall stress and potentially cause false lumen propagation.

83

Long-term Antihypertensive Treatment

- After initial stabilization with intravenous antihypertensive, start oral
- May require beta-blocker plus additional classes of agents
- Angiotensin-converting enzyme inhibitors or angiotensin receptor blockers
 - May also retard aortic dilatation

84

Nursing Care

85

Preoperative Care

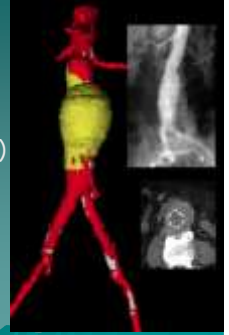
- ▾ Usually AM admit
- ▾ Hydrate with NS at 125 -150 ml/hour
- ▾ If Creatinine > 1.6 may give Mucomyst or Bicarbonate infusion (3 amps Bicarb/1000ml D5W at 3 ml/hr x 6 hours --- start 1 hour preop)
- ▾ Permit to include possible resection of aortic aneurysm
- ▾ Teaching

86

Preop Diagnostics

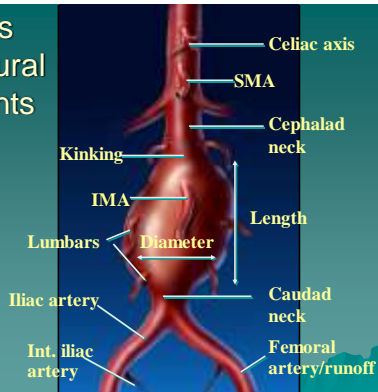
To measure length & diameter of the arteries

- ▾ Duplex scan
- ▾ CT (without contrast)
- ▾ Aortogram (with calibrated catheter)
- ▾ Spiral CT
- ▾ Intravascular ultrasound
- ▾ 3-D CT Reconstruction



87

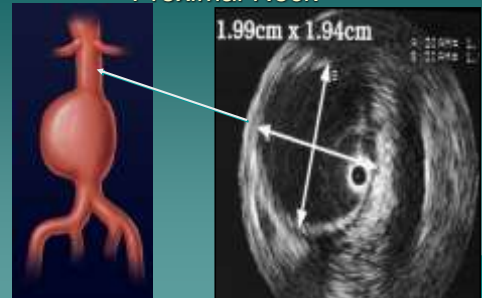
Numerous Pre-procedural Assessments



88

Intravascular Ultrasound

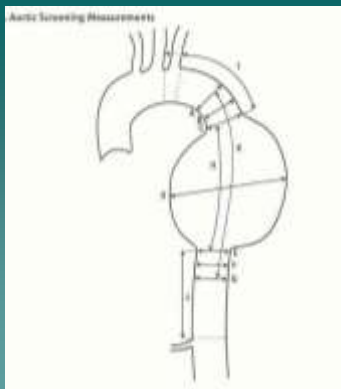
Proximal Neck



89

TAA

Pre-procedural Assessments



90

Postop Nursing Care

91

Management TAG/ELG vs Debranching

TAG & ELG

- Hourly neurovascular checks to extremities
- Immediate notification if decreased movement or sensation in legs-- may need to insert cerebral spinal catheter
- Lactate levels
- Pulmonary Toilet

TAG with debranching

- Volume resuscitate. Keep CVP high
- If hypotensive & hypovolemic, grafts can clot off
- Treat like a trauma or open abdominal surgery --- treat with hypotension with fluids not inotropes until tanked up.
- If Carotid arteries bypassed, hourly neuro checks

92

Postoperative Assessment, Complications & Care

- Endoleaks
- Extremity Ischemia
- Urinary Retention
- Renal Failure
- Bowel Ischemia
- Abdominal Compartment Syndroms
- Spinal Ischemia (TAA)
- Stroke
- Metabolic Acidosis
- Respiratory Complications

93

Endoleak

Aneurysm sac remains pressurized

Endoleak Significance

Endoleak = Endopressure \neq Protection

94

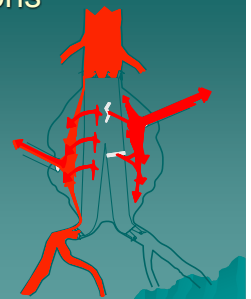
Perigraft Flow/Endoleak: Definitions*

Type I
Attachment leak

Type II
Branch flow

Type III
Defect in graft or modular disconnection

Type IV
Fabric porosity



* White et al., Endoleak Classification, Journal of Endovascular Surgery, 1998;5:305-309

95

Post-operative Detection of Endoleak

Assessment of aneurysm diameter & volume

- Abdominal four view xrays POD #1
- CT with 3-D reconstruction
- Duplex Scan
- For severe endoleak = hemodynamic instability

96

Extremity Ischemia

- Due to thrombosis of graft or groin hematoma at insertion site
- Assess pedal pulses, *sensation*, color, and temperature of extremities every 15 minutes x 4 and then hourly.
- Assess for pain in the hip(s) or leg(s) during walking
- Ankle brachial indexes bilaterally POD #1

97

Urinary Retention

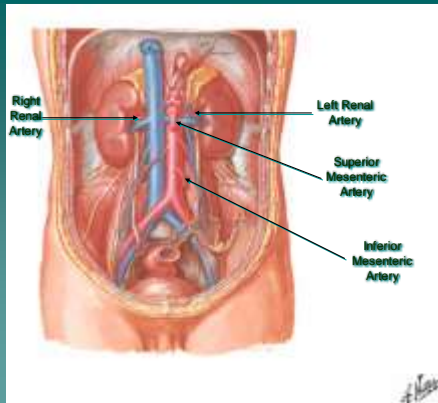
- ▼ Due to enlarged prostate
- ▼ Discontinue foley in OR or immediately upon admission to unit to prevent urinary retention

98

Renal Failure

- ▼ Due to occlusion of renal arteries by graft
- ▼ Due to atheroembolism
- ▼ Due to contrast induced nephropathy
 - 200 – 250 mg of contrast used per procedure case
 - HYDRATE preoperative

99



100

Bowel Ischemia

- ▼ Mesenteric Artery ischemia
 - **Due to occlusion or hypoperfusion of mesenteric artery ischemia**
 - **Due to atheroembolism**
 - **Will do bypass if think graft may cover mesenteric artery**
- ▼ Paralytic ileus
 - **Gastric distention**
 - **Retroperitoneal bleeding**
 - **Mesenteric ischemia**
 - **Drugs (narcotics)**

101

Bowel Ischemia

- ▼ Assess for
 - Loose stool or diarrhea
 - Bright red blood per rectum, blood streak stool
 - Abdominal pain out of proportion to physical findings
- ▼ Decompress bowel with nasogastric tube and keep NPO

102

Mesenteric ischemia

- ▼ Early diagnosis and treatment are essential to lower mortality
- ▼ Mortality generally exceeds 50%
- ▼ When ischemia is prolonged, irreversible intestinal necrosis may occur within hours
- ▼ Emergency abdominal exploration is indicated if bowel necrosis is suspected

103

Intra-abdominal hypertension (IAH) and Abdominal Compartment Syndrome (ACS)

104

Signs of Intra-abdominal hypertension (IAH) and Abdominal Compartment Syndrome

- ▼ Cardiac
 - Low CO with ↑ CVP/PAD
- ▼ Renal
 - Low urine output
- ▼ Pulmonary
 - Dyspnea
 - ↓ tidal volumes
 - ↑ intrathoracic pressures
- ▼ GI
 - Nausea/vomiting
 - Abdominal pain
 - Abdominal distension
- ▼ Neuro
 - ↑ICP
 - Anxiety
 - Confusion
 - Lethargy

105

IAH and ACS

- ▼ In high risk patients, measure intra-abdominal pressure (IAP) via bladder pressure measurements
 - Get baseline
 - Measure every 2 – 6 hours
- ▼ IAH = IAP \geq 12 mmHg
- ▼ ACS = IAP > 20 mmHg and associated organ failure/dysfunction

106

Spinal Cord Ischemia (SCI)

- ▼ The spinal cord like the brain
 - No room for anything but the cord and CSF
 - And it is unyielding to increased spinal pressures
- ▼ Paralysis
 - Occurs in about 3 - 6% of all repairs of the descending thoracic aneurysm
 - Due to interference in the blood supply to the spinal cord
- ▼ May occur immediately postop or from 1 – 21 days



107

Spinal Cord Ischemia

- ▼ Ischemia to the cord
 - Leads to cord edema
 - Can cause the lumbar ICP to rise & impede normal flow of CSF within the spinal cana
- ▼ Thoracic or lumbar spinal cord damage causes paraplegia
- ▼ Similar to muscular 'compartment syndrome'

108

Spinal Cord Ischemia (SCI)

- ▼ The mechanisms leading to SCI:
 - The interruption of multiple branch vessels that provide spinal cord perfusion.
- ▼ Hypotension - MAP < 70 - 90
 - Periop &/or postop
 - Can be a precipitating factor causing SCI

109

At risk for permanent and transient paraplegia

- ▼ Complicated Type B dissection
- ▼ Hybrid aortic procedures
- ▼ Aortic transection
- ▼ Chronic renal failure
- ▼ Smoking

110

Prevention of Spinal Cord Ischemia

- ▼ Prevent Hypotension MAP < 70 - 90
 - Treat with fluids to keep CVP > 6

111

Treatment Spinal Cord Ischemia

- ▼ Drainage of the lumbar CSF can reduce the risk of cord damage when reducing pressure to < 7 - 10 mmHg
- ▼ Keep MAP > 90 - 99 mmHg

112

Lumbar Cerebral Spinal Fluid Drain

- ▼ Also called:
 - **Lumbar drain, Lumbar subarchonoid catheter, intrathecal catheter, CSF drain**
- ▼ Placed in the Lumbar Subarachonoid space
- ▼ Use for those at high risk for paraplegia
 - **Previous infrarenal repair**
 - **Long segments of spinal cord**
 - **Spinal pressure > 10 cm H₂O**

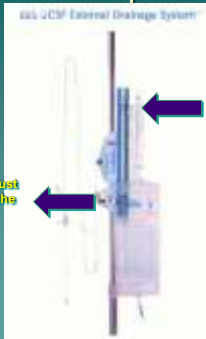


113

Lumbar Cerebral Spinal Fluid Drain

Purpose
Prevent
paraplegia

The "Zero" reference point must be positioned at the level of the catheter insertion site



Adjust drip chamber height until black level is at the proper drainage resistance. Frequently 10 cmH₂O

114

Lumbar CSF Drain Safety

- ▼ Place CSF transducer on opposite side of bed as hemodynamic pressure monitoring
- ▼ Must be a nonflush pressure system
- ▼ Turn drainage system off when getting patient up to chair
- ▼ Level after repositioning patient
- ▼ Remember to unclamp
- ▼ Aseptic technique is a must!

115

Spinal Ischemia Assessment

- ▼ Record CSF output hourly
- ▼ Notify MD if CSF drainage is > 20 – 30 ml/hr
- ▼ Note color of CSF
- ▼ Hourly spinal cord assessment for changes in sensation and/or movement

116

CSF Drainage

- ▼ Maintain CSF pressure 10 – 15 mmHg for the first 24 hours
- ▼ Then let rise to 15 mmHG
- ▼ If CSF pressure goes up above normal, blood flow to the spinal cord goes down, resulting in cord ischemia

117

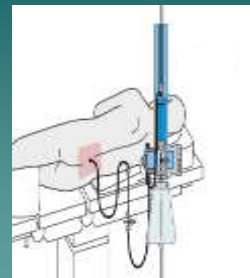
Complications of CSF Drain

- ▼ Infection
- ▼ Overdrainage
 - Subdural hematoma
 - Herniation
- ▼ Spinal cord hematoma
- ▼ Headache
- ▼ Pneumocranium (from air entering system)

118

Complication of CSF Lumbar Drain Overdrainage

- ▼ Low pressure headache
- ▼ Radiculopathy
- ▼ Pneumocephalus
- ▼ **Sagging Brain / intracranial hypotension**
- ▼ Hemorrhage
- ▼ Subdural, intradural Hematoma
- ▼ Cranial nerve palsies
- ▼ Tension Pneumocephalus
- ▼ Brainstem herniation



119

Post removal of Lumbar drain

- ▼ Cap 24 hours prior to removal
- ▼ Assess for lower extremity weakness or loss of sensation
- ▼ SCI can occur up to 30 days post op.
- ▼ Teach patients to come to ED immediately for aggressive treatment if they notice any change, numbness, or weakness in their legs.

120

Stroke

- ▼ 4- 7% risk
- ▼ Routine neuro checks

121

Respiratory Complications

- ▼ Due to general anesthesia and smoking
 - Incentive Spirometry every 1- 2 hours while awake
 - Aggressive Activity
 - ◆ HOB 30°
 - ◆ Chair when stable
 - ◆ Ambulate 200' evening of surgery
 - ◆ Then Ambulate 4- 6 times per day
- ▼ Left Pleural Effusion
 - Something may be bleeding

122

Serum Lactate levels

- ▼ Serum Lactate levels every 4 hours x 24 hours
- ▼ Level will be around 4 – 5mmol/L on admission
- ▼ Lactate levels need to decrease
- ▼ May be the first indication that something is wrong

123

Discharge

- ▼ Abdominal – POD #1 from CVICU
- ▼ Thoracic -- POD #2 or 3
- ▼ Teaching
- ▼ 10 days post procedure the patient should be back to normal activities
- ▼ MRI conditional up to 3 Tesla

124

Follow-up

- ▼ CT scan at 1, 2, 6, and 12 months and then annually to assess for aortic growth
- ▼ Teaching
 - Avoidance of exertional activities
 - ◆ Betablockers blunt pressure spikes
 - Avoidance of extreme emotional upsets

125