Anesthesia management in endovascular procedure

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Cardiac Anesthetist
This technique was first suggested by dotter in 1969 and clinical in 1990.

The advantage:

- Less invasive procedure
- Aortic occlusion insignificant
- Less hemodynamic and metabolic stress
- Ambulate and discharge earlier
- Overall cost
preoperative

- Cardiac, pulmonary, antiseizure medication
- ACE inhibitor, AR blocker (day)
- Oral hypoglycemic agent (night) except metformin (day), Insuline (up to 50%)
- Warfarine
- Plt receptor inh (clopidogrel), abciximab
- Aspirine
Cougulopathy, increase the risk for hemorrhage associated with neuraxial technique such as lumbar CSF drainage, epidural analgesia

Cervical spine, Esophageal dis prohibit the use of intraop. TEE
Anesthetic Management

- Thoracic Endovascular Aortic Repair (TEVAR)
- Descending thoracic and TAAA
- Balanced general anesthetic, neuroaxial, local.
- Invasive blood pressure preferred right radial art.
- CVP monitoring, PAC may be helpful
- TEE may assist in hemodynamic monitoring, procedural guidance and leak det
- SSEP, MEP for spinal cord monitoring
The risk factors for spinal cord ischemia after TEVAR

Perioperative hypotension (decrease scpp)

Prior abd/desending thoracic aortic proced
(compromised spinal collateral art network)

Coverage of the entire des tho aorta
(loss of intercostal arteries).
The risk factor for stroke after TEVAR

- History of prior stroke
- Mobile aortic arch athroma
- Proximal des thoracic art.

(detection of mobile athroma in arch by TEE is important for predicts a greater stroke risk)
Indication for CSF drainage in TEVAR

- Extensive coverage of the des. Tho. aorta.
- History of prior abd/ des. tho. aortic procedure.
- Postoperative paraparesis/ paraplagia despite relative HTN.
SCPP: MAP – CSF PRESSURE

The scpp should be maintained greater than 70 mmHg after TAAA repair, that is, a MAP of 80 to 100 mmHg.
- Tube grafts reinforced by a wire frame that collapsed within a catheter for delivery of aortic lumen.
- TEVAR requires a landing zone for each end of the tubular graft.
- Two major option for endovascular TAAA repair: Total and Hybrid TEVAR.
- Total repair preserve major aortic branches With fenestration or side branches (high risk).
Hybrid repair need aortic debranching for landing zone (lt subclavian art, renal and mesenteric arteries)

TEVAR as compare with open aortic repair reduced perioperative mortality, paraplegia, pneumonia, cardiac complication, renal failure, bleeding and hospital stay.
Case #1: Pre-Implant CT Angio
Case #1: Proposed Treatment Solution

A fenestrated stent-graft solution was developed to maintain celiac trunk perfusion, and exclude pseudo-aneurysm endovascularly.
Case #1: The Stent-Graft

Custom-made fenestrated stent-graft developed by Cook Medical

- Sheath Type: Flexor Sheath with Captor Valve
- Sheath Length: 50cm
- ID: 20FR
- OD: 7.8mm
Case #1: Post-Implant CTA

Final angio showing perfusion of celiac trunk, exclusion of pseudo-aneurysm
Case Report #2:

- 68yr old male
- 75mm juxta-renal aorto-iliac aneurysm
- 3mm landing zone from left renal artery
- 40° infrarenal aortic angulation
- 38mm right CIA
- Family history of AAA (cause of death in patient’s brother)
Case Report #2:
Case #2: Plan

- Fenestrated Tube-graft for juxta-renal aorta
- Two V12 covered stents for renal arts.
- Iliac branch device for right CIA
- One V12 covered stent for right IIA
- Bifurcated main body stent graft for abdominal aorta
- Connecting stent between bifurcated main body and Iliac branch device
Case #2: Cook Custom Made Device

As Made and Loaded

Anterior Markers

Diameter Reducing Ties

Posterior Markers

Scallop @ 11:30
Small Fenestration @ 2:45
Small Fenestration @ 8:00
Case #4

- 75yr old female
- 54mm aneurysm in aortic arch (no proximal landing zone to brachiocephalic artery)
- Another 32mm saccular pseudo-anerysm which was 4cm distal to arch
- Very large innonimate artery (16mm in diameter)
Case #4: Plan

- RCA to LCA to LSA bypass
- Ligation of LCA and LSA
- Two V12 Chimney stents from right axillary
- One Zenith TX2 tube-graft placed in Zone 0 (ascending aorta) to Zone 4 (T5 of descending aorta)
Case #4: Implant Angio

First angio showing bypass grafts
Case #5

- 72yr old male
- 56mm thoraco-abdominal-aortic-aneurysm (TAAA)
- Symptomatic
- History of CABG
- On Dialysis
- Hypertensive
Case #5: Plan

- Cook t-Branch device (off-the-shelf branched stent-graft)
- Staged procedure
- Two Atrium V12s for the SMA and celiac
- Two PDA plugs for the renal branches
Case #5: The Device (Cook t-Branch)

**SMA Branch**
- Diameter: 8 mm
- Length: 18 mm
- Distance from proximal end of graft to distal end of branch: 117 mm
- Clock: 12:00

**Celiac Branch**
- Diameter: 8 mm
- Length: 21 mm
- Distance from proximal end of graft to distal end of branch: 99 mm
- Clock: 1:00

**Right Renal Branch**
- Diameter: 6 mm
- Length: 18 mm
- Distance from proximal end of graft to distal end of branch: 135 mm
- Clock: 10:00

**Left Renal Branch**
- Diameter: 6 mm
- Length: 18 mm
- Distance from proximal end of graft to distal end of branch: 135 mm
- Clock: 3:00
Case #5: The Steps

**Step 1**
Insertion and deployment of the t-Branch component (retrograde)

**Step 2**
Cannulation and stenting of the visceral branche one-by-one (antegrade)

**Step 3**
Insertion & Deployment of distal bifurcated main body (retrograde)

**Step 4**
Extension into the common iliacs with iliac extension devices (retrograde)
Anesthetic management in TAVI or proximal graft

- Induced hypotension during device deployment may reduce the magnitude of migration due to forward aortic blood flow (reduce occlusion of major art. branches or incomplete aneurysm exclusion)

- Minimal induced hypotension are usually adequate (fast-acing venous or art. vasodilator)
Adenosine induced asystol increase the accuracy of device positioning.

High dose adenosine induce temporary high degree AV block and asystol during device deployment.

Temporary external T.T pacing and defibrilation pads for manage. prolong Av block.
- General, neuroaxial or local anesthesia Rt radial art, Rt int juglar, PAC.
- Sedate with etomidate 0.1-0.2 mg/kg or propofol 1-mg/kg during angioplasty balloon inflation or aden. induced asystol
- Permanent pacemaker reprogram to prevent capture during induced asystol.
- Adenosine 24mg (48, 60, 90)
- Temporary pace. if asystol exceed 15-20 sec
Ventricular fibrilation

- Alternative technique to induce temporary asystol, highly invasive technique. A 10 sec V.F was induced by A/C transformer and defib. with 200j shock via the ext. pad

- V.F, flat intra art press tracing (several times)

- After deflation of angioplasty balloon the pts was defibril 200j
T.E.E

- Perioperative dynamic views of the cv sys
- Diagnostic aortic pathology.
- Location of the guidwires and endografts prior to deployment.
- Exclusion of flow from the aorta into aneurysm by doppler color flow imaging
- TEE probe interfered with fluoroscopic imaging
- Color-flow doppler exclude any persistent leaks from the aorta into the aneurysm or pseudoaneurysm at the endograft margins.
- Confirmed patency of the intercostal artery.
- Visualization of the distal ascend aorta and proximal aortic arc may be limited.
First human implantation: Alain Cribier
April 16, 2002 (France)

Bovine pericardium valve
23mm in diameter
The principal transcatheter aortic valve implantation devices currently in use.
(A) Edwards Sapien bioprosthesis and
(B) Medtronic eCoreValve® bioprosthesis.
## Indications for transcatheter aortic valve implantation

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**TAVI should only be undertaken with a multidisciplinary “heart team” including cardiologists and cardiac surgeons and other specialists if necessary.**

**TAVI should only be performed in hospitals with cardiac surgery on-site.**

**TAVI is indicated in patients with severe symptomatic AS who are not suitable for AVR as assessed by a “heart team” and who are likely to gain improvement in their quality of life and to have a life expectancy of more than 1 year after consideration of their comorbidities.**

**TAVI should be considered in high risk patients with severe symptomatic AS who may still be suitable for surgery, but in whom TAVI is favoured by a “heart team” based on the individual risk profile and anatomic suitability.**

 европейски език

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**ТАВI трябва да бъде извършван само с участието на хърт тим с участието на кардиологи, кардиохирурги и други специалисти, ако е необходимо.**

**ТАВI трябва да бъде извършван само в болници с кардиохирургия на място.**

**ТАВI е указани за пациенти с тежки симптоматични AS, които не са годни за AVR, оценени от хърт тим и които очакват да получат улеснение на качеството на живот със срок за здраве над 1 година след разглеждане на своите коморбидности.**

**ТАВI трябва да се разглежда за висок риск пациенти с тежки симптоматични AS, които все още могат да бъдат годни за хирургия, но при които ТАВI е предпочитан от хърт тим, съобразявайки се с индивидуалния рисков профил и анатомичната съвместимост.**

Contraindications for transcatheater aortic valve implantation

<table>
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<td>Absence of a “heart team” and no cardiac surgery on the site.</td>
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<td>Appropriateness of TAVI, as an alternative to AVR, not confirmed by a “heart team”.</td>
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**Clinical**
- Estimated life expectancy < 1 year.
- Improvement of quality of life by TAVI unlikely because of comorbidities.
- Severe primary associated disease of other valves with major contribution to the patient’s symptoms that can be treated only by surgery.

**Anatomical**
- Inadequate annulus size (< 18 mm, > 29 mm).
- Thrombus in the left ventricle.
- Active endocarditis.
- Elevated risk of coronary ostium obstruction (asymmetric valve calcification, short distance between annulus and coronary ostia, small aortic sinuses).
- Plaques with mobile thrombi in the ascending aorta, or arch.
- For transfemoral/subclavian approach: inadequate vascular access (vessel size, calcification, tortuosity).

**Relative contraindications**
- Bicuspid or non-calcified valves.
- Untreated coronary artery disease requiring revascularization.
- Haemodynamic instability.
- LVEF < 20%.
- For transapical approach: severe pulmonary disease, LV apex not accessible.
TAVI patient`s Work up

- Pre-anesthetic work up.
- Cardiothoracic Surgical Evaluation [access, AVR, risk assessment]
- Imaging (Pre-procedure) (Echo; CT-Angio ; U/S):
  - TTE: AS severity, valve morphology, calcification
  - TEE: Annular size and shape (TEE [2D / 3D]; CT Angio; CMR).
    ~ LV function (LVEF > 20%).
    ~ Other valvular disease, sub aortic obstruction; PASP.
- CT-Angio Aortic root:
  ~ annulus to coronary ostia (>8mm), Aortic Atheroma, ca
  ~ Vascular anatomy from access site to annulus (Ilio-femoral).
- Imaging (post procedure) (Echo … MRI):
  ~ Degree of AR; MV assessment; new LV RWMA.
  ~ Cerebrovascular embolism.
Vascular access sites

- TRANSFEMORAL
- TRANSAPICAL
- TRANSAORTIC
- TRANSSEPTAL
- RETROPERITONEAL
- TRANSCAROTID
- TRANSAXILLARY

Are the latest access sites applicable for TAVI?
Complications of endovascular aortic repair

- Hypotension
- Spinal cord ischemia
- Post implantation syndrome
Hypotention

- Intraoperative aortic rupture (the anesthe team must be prepared for resusitation)
- IV,CVP,ART Press, Inotrope, Vasodilator.
- DDX
- Sympa. nerve blockade by regional anes.
- Acute aortic rupture, endoleak
- Allergic reaction
- Adenosine(peripheral dilation, Avblock)
Spinal Cord Ischemia During E.V Taa Repair

- The typical level ischemia after TAA is midthoracic (high perioperative mortality)
- Thoracolumbar has multiple art. source and vulnerable to ischemia
- Adamkiewics (intercostal arteries t9-t12 in 75%) as watershed region.
- Ischemia after TAAA repair is variable, asymmetric, sensory or motor function
Paraplegia & paraparesis

Immediate onset: lower ext weaknes on emergence from anestesia within 24 hrs

Delayed onset: follows a normal post op neurrologic exam after emergence from anes.

Incidence rate: 3-4% immediate: 63%

Immediate: irreversible

Immediate: infarction, delay: ischemic

Cosequently, strategies to prevent immediate parapl. are directed toward intra op protection.
Intraoperative S.C monitoring is to detect S.C ischemia for immediate intervention to improve S.C perfusion. (SSEP, MEP)

Strategies to minimise delayed onset:

- Prevention of periop. hypotension
- Early anest. emergence for early and subsequent serial neurilogic assessment.
- Lumbar CSF drainage.
Prevention & treatment of delayed onset S. C. ischemia

- MAP $> 85$
- Augment SCPP
- Increase MAP with vasopressor therapy
- CSF drainage
- Prevent hypotension
Lumbar CSF drainage

- Spinal cord protective strategy for TAAA repair.
- Reduction of CSF pressure improves SCPP
- Silicon elastomer ventriculostomy catheter, 14 gauge needle at the L3-L4.
- Advanced 10-15 cm into the subarachnoid space.
- CSF is drained when CSF pressure exceeds 10 mmHg.
Pressure transducer zero-referenced to the midline of the brain.

Inserted before or at the time of surgery up to the 24 hrs after surgery.

SCPP: MAP-CSF pressure.

The scpp should be maintained greater than 70mmHg, MAP about 80-100mmHg in TAA Vasopressor therapy in spinal vasodilatory shock (significant sympathectomy)
Complication of CSF drainage

- Neuraxial hematoma
- Catheter fracture
- Meningitis
- Intracranial hypotension
- Spinal headache
Decrease the risk for intraop. SC ischemia

- Mild systemic hypotermia
- Lumbar CSF drainage
- Epidural cooling (cold saline)
- Pharmacologic neuroprotection
- Intraop. SSEP, MEP monitoring
- Arterial pressure augmentation
Pharmacologic protection

- Systemic glucocorticoids, manitol, gabapentin
- Esmolol, anti infl. agents, intrathecal (papaverine, mgso4, naloxan)
- Erythropoitin (promote the recruitment of bone marrow mesenchymal stem cells to the site of injured spinal cord and repair of neurons, glial cells)
- Xenon, inert gas, neuroprotective property
POST IMPLANTATION SYN

- After endovas. Aortic repair
- Fever, elevated CRP level
- Leukocytosis in the absence of an infectious agent
  - Mild, self limited, 2-10 days postop
- (hyperpyrexia, hypotension, coag).
Occasionally, excessive capillary permeability,
Leakage lead to life threatening intravasal hypov
Res. failure, DIC
(due to sig. inflam. response, endothe. activation
From intra aneurysmal device manipulation)
Conclusion

- Endovascular aortic repair is a minimally invasive procedure which may offer many advantages over open aortic repair.

- Success at least 80-90%.

- The perioperative mortality is most likely less than conventional surgical repair.
Thank you