Cardiology Update
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Anchorage, Alaska

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Heart Place
DFW Metroplex
Dedicated to

James Almand, M.D.

Physician
Aviator
Patriot
Leader
 Educator
   Friend
Cardiology Case #1

- Still flies F-15's
- Visiting Lake of the Ozarks and played 36 holes of golf in extreme heat and humidity. During his final round, he developed chest discomfort at rest and was seen in the local hospital where he was found to have a mildly elevated troponin but only nonspecific EKG changes. His pain resolved spontaneously but he did undergo cardiac catheterization.
- This study revealed no significant coronary artery disease but a large anteroapical myocardial wall motion abnormality was seen with an ejection fraction of 30-35%.
Takotsubo’s Cardiomyopathy
Takotsubo’s Cardiomyopathy

- First described in Japan 1990
- 90% in women age 58-75
- 5% of women’s heart attacks
- Angina and SOB
- Emotional or physical stress (broken heart syndrome)
Takotsubo’s Cardiomyopathy

- EKG indistinguishable from MI
- Small troponin elevations
- Adrenaline stunning of myocardium
- 20% CHF
- Beta blockers, ACE, diuretics and antiplatelets
Takotsubo is Japanese for Octopus Trap
TAKOTSUBO CARDIOMYOPATHY

The prognosis is excellent, with nearly 95% of patients experiencing complete recovery within 4-8 weeks.
Takotsubo’s Cardiomyopathy: Aviation Medical Certification

- Three months downtime and then eligible for SI
- CVE and records review including cath CD
- Repeat echocardiogram documenting LVEF 40% or greater
- Stress test and Holter monitor
Cardiology Case #2

- 80 WM retired airline captain active in general aviation
- Class 3 medical certification via special issuance for CAD with 2 previous CABG procedures
- Presents with severe dyspnea on exertion since last AME exam
- Grade 3/6 systolic ejection murmur right USB
- Echocardiogram shows LVEF 45% with severe calcific AS
- Coronary angiogram shows patent LIMA and SVGs
- Two cardiac surgeons turned him down for AVR
Transcutaneous Aortic Valve Insertion
TAVR

New guidelines July 2018 JACC
Over 120,000 patients in USA alone
582 active centers
Now approved for moderate risk patients
Surgical Aortic Valve Replacement

Indications

Severe high-gradient AS with symptoms (class I recommendation, level B evidence)

Asymptomatic patients with severe AS and LVEF < 50 (class I recommendation, level B evidence)

Severe AS when undergoing other cardiac surgery (class I recommendation, level B evidence)

Asymptomatic severe AS and low surgical risk (class IIa recommendation, level B evidence)

Symptomatic with low-flow/low-gradient severe AS (class IIa recommendation, level B evidence)

Moderate AS and undergoing other cardiac surgery (class IIa recommendation, level C evidence)
Transcutaneous Aortic Valve Insertion
TAVR
Indications

1. Intermediate to prohibitive surgical risk patients with severe AS
2. Valve-in-valve procedure for failed prior bioprosthetic valve
TAVR Contraindications

Life expectancy less than 12 months owing to a noncardiac cause

Myocardial infarction within the last thirty days

Congenital unicuspid, bicuspid or noncalcified valve

Hypertrophic cardiomyopathy

Ejection fraction less than 20%

Severe pulmonary hypertension

Intracardiac mass, thrombus or vegetation,

Severe mitral regurgitation,

MRI confirmed CVA or TIA within last six months

End-stage renal disease

Mixed aortic valve disease (concomitant aortic regurgitation) or significant aortic disease.
A multidisciplinary heart team evaluates patient

Team consists of cardiothoracic surgeons, anesthesiologists, and cardiologists.

Transesophageal echocardiography

Computed Tomography angiography of the chest, abdomen, and pelvis for accurate measurement of the aortic annulus for determination of valve size.

Left heart catheterization to rule out any coexisting coronary artery disease that may need revascularization
TAVR Technique

Two currently FDA-approved for use in the United States

SAPIEN valves (Edwards Lifesciences, Irvine, CA)
bovine pericardial tissue and a chromium cobalt alloy
frame. Balloon expandable. Approved for redo procedure.

CORE valves (Medtronic Fridley, MN)
Newest generation EVOLUT-R.
Porcine tissue and a nitinol frame.
Self-expandable and repositionable after deployment.

No head-to-head trials

The procedure is typically done in a hybrid room with
both operating room and cath lab capabilities. The team
consists of interventional cardiologist, cardiac surgeon,
and anesthesiologist.
TAVR Complications

Conduction disturbances and need for a permanent pacemaker

Stroke

Paravalvular leak or annular rupture

Vascular site complications or bleeding

Left ventricular perforation, cardiac tamponade
Special Issuance Medical Certification
TAVR

- 6 months downtime
- CVE and all records
- Follow up echocardiogram
- Holter
- ETT
Cardiology Case #3

- 57-year-old white male airline pilot for American Airlines assigned to the 777/787 Director of simulator training.
- Very healthy/athletic man with no previous cardiac history or known hypertension.
- Presented to the hospital with an acute right middle cerebral artery distribution stroke. He has fortunately recovered from that event nicely with no obvious neurologic deficits. As part of his workup in the hospital, he had carotid ultrasonography that showed no abnormalities. He also had a transesophageal echocardiogram that showed no valvular pathology, normal left ventricular function, normal cardiac chamber dimensions but did reveal evidence of a small patent foramen ovale with right-to-left shunting discovered by contrast administration.
- He has an implantable loop recorder in place that has shown no evidence of atrial fibrillation.
- Started on Coumadin
PFO Closure In Cryptogenic Stroke

- Estimated 1 in 4 people have a PFO
- Cryptogenic stroke under age 55--46% have PFO

Key factors for stroke:
- Size 2 mm or greater
- Atrial motion around defect
- Tissue protrusion through PFO-atrial septal aneurysm
PFO Closure In Cryptogenic Stroke

- 2016 Academy of Neurology - no benefit over medical therapy

- CLOSURE 1, PC Trial, RESPECT Amplatzer device vs antiplatelet or warfarin

- Higher risk of AF and perioperative complications

- Criticized for inclusion of nonembolic lacunar strokes, small PFOs and short 2 year follow up
PFO Closure

- RESPECT extended 5.9 years 16-28 in medical group, 9-18 in closure group. Own internal control study—takes longer to show difference.

- REDUCE (Helex and Cardioform) - 82% moderate or large PFO. P = .001

- CLOSE - 663 patients 7% NOAC and 11 different devices – large shunt or atrial septal aneurysm only

60%-70% recurrent stroke reduction
5% AF risk in first 2 months gone by 3 months
1/500 chest pain requiring device removal
Nickel allergy for Amplatzer
Most Recent Study PFO Closure
DEFENSE-PFO Trial

- South Korean study
- 120 patients randomized to medical therapy vs PFO closure+meds
- No NOACs used
- Composite endpoint of stroke, major bleeding or vascular death
- 2 year follow up
- 0/60 in PFO closure
- 6/60 strokes and 1/60 TIA in medical therapy alone
- Treat 10 to prevent 1 stroke within 2 years
- 10% recurrent stroke risk in medically treated group
- JACC 3/2018
CENTRAL ILLUSTRATION: Evidence-Based Algorithm for PFO Closure in Ischemic Stroke Patients for Highest Clinical Yield, Based on Randomized Trials

Biological age ≤60 years ischemic stroke, and PFO

- Large artery atherosclerosis
- Cardioembolic source
- Small vessel disease
- Arterial dissection
- Hypercoagulable disorder

No

- Uncontrolled hypertension
- Uncontrolled diabetes
- Autoimmune disease
- Drug or alcohol abuse

No

- Atrial fibrillation or flutter (ideally ≥30-day cardiac monitoring)

No

- <1 year of life expectancy
- End-stage heart, liver, lung, or kidney disease
- Cardiac tumor
- Endocarditis or septicemia
- Severe valvular pathology

Yes

Medical therapy

Percutaneous PFO closure

Enhanced reasons for PFO closure:
- Prior venous thromboembolism
- Multifocal cerebral defects
- Large PFO
- Atrial septal aneurysm
- Eustachian valve or Chiari network

Cardiology Case #4

- 82 yo WM pilot with persistent AF CHADS 3 on Eliquis with HTN and AODM
- Class 3 medical certification via SI
- Normal EF and no valvular disease
- No CAD by nuclear stress testing
- Develops recurrent diverticular bleeding
Atrial Fibrillation is a Prevalent and Growing Condition and a Leading Cause of Stroke

- **5X** increased risk of stroke for AF patients\(^2\)
- **1 in 6 strokes** occur in patients with AF\(^3\)

\(~5M\) people with AF in U.S., expected to more than double by 2050\(^1\)

**47%** of AF patients experiencing a stroke will **suffer a second stroke** within 6 months\(^4\)

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2014 ACC/AHA/HRS Treatment Guidelines to Prevent Thromboembolism in Patients with AF

► Assess stroke risk with CHA$_2$DS$_2$-VASc score

► Score 1: Annual stroke risk 1%, oral anticoagulants or aspirin may be considered

► Score ≥2: Annual stroke risk 2%-15%, oral anticoagulants are recommended

► Balance benefit vs. bleeding risk

<table>
<thead>
<tr>
<th>CHA$_2$DS$_2$ VASc Score</th>
<th>Recommendation</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>No anticoagulant</td>
</tr>
<tr>
<td>1</td>
<td>Aspirin (81-325 mg daily) or warfarin (INR 2-3)</td>
</tr>
<tr>
<td>≥2</td>
<td>Oral anticoagulants are recommended (warfarin (INR 2-3), dabigatran, rivaroxaban or apixaban)</td>
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January, CT. et al. 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation. JACC. 2014; doi: 10.1016/j.jacc.2014.03.022
Left Atrial Appendage Closure

Watchman and Amulet devices
Left Atrial Appendage with WATCHMAN Device
WATCHMAN™ Device Endothelialization

Canine Model – 30 Day

Canine Model – 45 Day

Human Pathology – 9 Months Post-implant (Non-device related death)

Images on file at Boston Scientific Corporation.
Results in animal models may not necessarily be indicative of clinical outcomes.
PREVAIL  And Protect-AF Study

WATCHMAN left atrial appendage closure device

5 year data

Warfarin vs device for high risk nonvalvular AF

Decreased major bleeding,

55% reduction in disabling or fatal stroke and mortality

80% reduction in hemorrhagic stroke

27% reduction in all-cause mortality
WATCHMAN Significant Reduction in Disabling Strokes (Patient-Level Meta-Analysis)

Disabling Stroke defined as MRS ≥2
Two strokes in PREVAIL are excluded because the baseline MRS score was unavailable

Disabling/Fatal Strokes
Non-Disabling Strokes

HR 0.45 (0.21 – 0.94)
P=0.03
55% Lower
Bleeding Outcomes after Left Atrial Appendage Closure Compared with Long-term Warfarin

72% Freedom of Major Bleeding Over 3 Adjunctive Pharmacotherapy Intervals

>6 months post-procedure


p < 0.001
92% of patients were able to discontinue warfarin after 45 days, with >99% able to discontinue after 1 year.

Warfarin Cessation with WATCHMAN

<table>
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<tr>
<th>Study</th>
<th>45-day</th>
<th>12-month</th>
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<tbody>
<tr>
<td>PROTECT AF</td>
<td>87%</td>
<td>&gt;93%</td>
</tr>
<tr>
<td>CAP</td>
<td>96%</td>
<td>&gt;96%</td>
</tr>
<tr>
<td>PREVAIL</td>
<td>92%</td>
<td>&gt;99%</td>
</tr>
</tbody>
</table>

EWOLUTION - low annual stroke rate in full cohort

Expected, based on CHA2DS2-VASc*

Observed in EWOLUTION

Ischemic Stroke

Expected: 7.2%
Observed: 1.1%
RR 84%

Ischemic Stroke/TIA/SE

Expected: 10.1%
Observed: 1.5%
RR 85%

*Effectiveness in stroke reduction vs. estimated in the absence of therapy for comparable CHA2DS2-VASc scores based on Friberg et al. EHJ 2012

These data are for the full cohort of patients, 73% of whom may be contraindicated in the US per current labeling

MitraClip
Percutaneous Mitral Valve Repair

▶ 60,000 patients since 2008

▶ High risk patients with severe mitral regurgitation who are not surgical candidates
Consistent results seen in the STS/ACC TVT Registry

**MR Severity ≤ 2+**
Clinical and Real-World Results

- **Baseline**
  - Clinical Trial: 9.7% (N = 124)
  - Real-World: 4.8% (N = 564)
- **30 Days**
  - Clinical Trial: 82.1% (N = 123)
  - Real-World: 86% (N = 564)

**NYHA Functional Class I/II**
Clinical and Real-World Results

- **Baseline**
  - Clinical Trial: 13.4% (N = 124)
  - Real-World: 14% (N = 564)
- **30 Days**
  - Clinical Trial: 82.3% (N = 113)
  - Real-World: 78.8% (N = 564)

Patient characteristics and 30-day results are consistent with prohibitive risk DMR cohort.
Immediate and durable improvements in MR severity and HF symptoms seen up to 3 years\textsuperscript{1,2}\textdagger

**Reduction in MR Severity**

- **Baseline (N = 120):** 17.7% MR ≤ 2+
- **Discharge (N = 123):** 82.1% MR ≤ 2+
- **1 Year (N = 84):** 83.3% MR ≤ 2+
- **3 Years (N = 35):** 80.0% MR ≤ 2+

**Improvement in Heart Failure Symptoms**

- **Baseline (N = 127):** 13.4% Class III
- **30-Days (N = 113):** 82.3% Class I/II
- **1 Year (N = 84):** 86.9% Class I/II
- **3 Years (N = 44):** 79.5% Class I/II
Clinically important improvements seen in other meaningful measures

**Reduction in the Rate of Hospitalizations for Heart Failure**

- **1 YEAR PRIOR TO MITRACLIP® (N = 127)**: 0.67
- **1 YEAR POST-DISCHARGE (N = 120)**: 0.18
- 73% Reduction

**Left Ventricular End Diastolic Volume**

- **BASELINE (N = 27)**: 127.8 mL
- **3 YEARS**: 117.5 mL
- $\Delta = -10.3$ mL

A reduction in heart failure hospitalizations was reported in the 12 months post-MitraClip® procedure from 12 months pre-MitraClip® procedure.\(^1\)

Reduced preload as a result of the reduction in MR severity resulted in reverse left ventricular remodeling.\(^2,1\)
66 yo WM pilot with dual chamber pacemaker for complete AV block 5 years ago
Class 3 medical certification with pacemaker dependence
Reports new moderate DOE
Echocardiogram shows 35% EF with previous echocardiogram 55% EF 2 years prior
No evidence of ischemia by nuclear stress testing
RV Pacing Cardiomyopathy

Approximately 20% will develop with RV pacing 40% of the time
Defined as greater than 10% decrease in EF
EF decreases from 60%-35%
QRS duration >115 ms at increased risk
Treatment includes CHF meds and cardiac resynchronization pacing (CRT)
CENTRAL ILLUSTRATION: Improvement in LVEF After CRT Upgrade

A

B

C

Development of severe PICM with LVEF ≤ 35%

Upgrade to CRT pacemaker

LVEF ≤ 35%

Consider CRT defibrillator

LVEF > 35%

Maintain CRT pacemaker

1 year response period
Special Issuance
Aviation Medical Certification for CRT

- Repeat echo shows EF 40% or greater
- Two months downtime
- No ICD device allowed
- Class 3 only with pacemaker dependence
the LORD will watch over your coming and going both now and forevermore.

Psalm 121:8