Surgical management of anomalous aortic origin of coronary artery

Burkhart HM

American Association for Thoracic Surgeons
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Disclosure

No personal equity, licensing or consulting agreements with the medical device or pharmaceutical industry to disclose
Coronary Artery Anomalies

• Rare, occurring in 1.3% (range 0.3-5.64%) of the population
• Often an incidental finding in asymptomatic pts
• 20% may have a life-threatening presentation
  • myocardial infarction
  • arrhythmia
  • sudden death
• In young athletes or in young military recruits, up to a 1/3 cardiac-related deaths in that age group are related to such anomaly
Table 1. Causes of Sudden Death in 387 Young Athletes.

<table>
<thead>
<tr>
<th>Cause</th>
<th>No. of Athletes</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>102</td>
<td>26.4</td>
</tr>
<tr>
<td>Commotio cordis</td>
<td>77</td>
<td>19.9</td>
</tr>
<tr>
<td>Coronary-artery anomalies</td>
<td>53</td>
<td>13.7</td>
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<tr>
<td>Left ventricular hypertrophy of indeterminate cause†</td>
<td>29</td>
<td>7.5</td>
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<tr>
<td>Myocarditis</td>
<td>20</td>
<td>5.2</td>
</tr>
<tr>
<td>Ruptured aortic aneurysm (Marfan’s syndrome)</td>
<td>12</td>
<td>3.1</td>
</tr>
<tr>
<td>Arrhythmogenic right ventricular cardiomyopathy</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Tunneled (bridged) coronary artery‡</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Aortic valve stenosis</td>
<td>10</td>
<td>2.6</td>
</tr>
</tbody>
</table>

**Coronary-artery anomalies**

- Myxomatous mitral-valve degeneration | 9 | 2.3 |
- Asthma (or other pulmonary condition) | 8 | 2.1 |
- Heat stroke | 6 | 1.6 |
- Drug abuse | 4 | 1.0 |
- Other cardiovascular cause | 4 | 1.0 |
- Long-QT syndrome§ | 3 | 0.8 |
- Cardiac sarcoidosis | 3 | 0.8 |
- Trauma involving structural cardiac injury | 3 | 0.8 |
- Ruptured cerebral artery | 3 | 0.8 |

* Data are from the registry of the Minneapolis Heart Institute Foundation.6,28
† Findings at autopsy were suggestive of hypertrophic cardiomyopathy but were insufficient to be diagnostic.
‡ Tunneled coronary artery was deemed the cause in the absence of any other cardiac abnormality.
§ The long-QT syndrome was documented on clinical evaluation.
AAOCA
Intramural intra-arterial course
Pathophysiology: Theories

- Slit-like ostium
- Intramural course
- Marked angulation
- Compression from PA
- Spasm from endothelial damage
- Minor ischemic events - arrhythmias
Normal Anatomy
Sudden Death

- Root expansion with increased CO may compromise diastolic coronary flow
Incidences

- 126,595 coronary angio in adults
- 1686 (1.3%) ACA
- 22 (0.017%) ALCA
- 136 (0.107%) ARCA

ARCA 6 x ALCA
22 y male SD soccer game
Symptoms

- Dyspnea
- Palpitations
- Angina pectoris
- Dizziness
- Syncope
- Sudden death
13 yr CP with hockey
13 yr CP with hockey
Routine Clinical Tests?
Anomalous LCA

- 25-yr review of autopsies in military recruits
  - 6.3 Million ; age 18-35 years
- 126 sudden nontraumatic death
  - Cardiac abnormalities in 64 (51%)
    - Anomalous CA origin in 21 (17% of SCD)

Anomalous LCA from Rt coronary sinus is potentially dangerous

Eckart; Ann Int Med, 2004
Anomalous RCA

- 25 yr review of clinical reports
- 10 ARCA deaths
  - All sudden deaths
  - All asymptomatic prior to event
  - Age 10-30 yr

ARCA more prevalent and less risky but can be deadly with SCD as the first manifestation

Gersony; JACC, 2007
13 yr CP with hockey
13 yr CP with hockey
Surgical Management of Anomalous Aortic Origin of a Coronary Artery

36 pt AAOCA
80% symptomatic

Unroofing 22
CABG 14

No mortality
1 CP recurrence CABG

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ATS 2009
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</table>
ALCA

Symptomatic → Surgery
Asymptomatic

ARCA

Symptomatic → Surgery

Asymptomatic

+ ve stress, acute angle slit-like orifice, young age intramural, compression

Observe*

Repair
Division of
Cardiovascular Surgery
Surgical management of anomalous aortic origin of coronary artery

Rebuttal

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May 2012
**CARDBIOVASCULAR FLASHLIGHT**

doi:10.1093/eurheart/ehr386

Anomalous origin of right coronary artery from the left coronary sinus: sudden death and successful surgical reimplantation

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A 39-year-old man with no clinical relevant data, elite long-distance runner, was admitted to our institution with the diagnosis of ventricular fibrillation while participating in a half-marathon competition. He was resuscitated at the site of the event with electrical cardioversion, and at his admission, he was clinically stable.

Electrocardiogram demonstrated regular sinus rhythm. Echocardiography showed normal biventricular function and no presence of hypertrophic cardiomyopathy. Cardio-magnetic resonance demonstrated no findings of arrhythmogenic right ventricular dysplasia and no other pathological data. Electrocardiogram-gated 64-slice computed tomographic angiography...
A 64-year-old woman with no previous cardiac history suffered an out-of-hospital cardiac arrest the day after her husband died. She had previously complained of chest tightness, but an exercise ECG performed 2 months before this episode had not elicited any chest pain or ECG abnormalities. She was found in ventricular fibrillation by a paramedic ambulance crew, who successfully cardioverted her to sinus rhythm before transfer to the emergency department.

The ECG on arrival demonstrated ST segment elevation (2 mm) in the inferior leads (II, III, and aVF), which subsequently progressed to pathological Q waves. Her serum creatinine kinase rose to a maximum of 1037 IU/L on the second day of admission. Left heart catheterization demonstrated localized inferobasal hypokinesia on ventriculography; it further indicated that the right coronary artery arose anomalously from the left posterior sinus of Valsalva (Figure 1), although there were no significant coronary stenoses. Subsequent cardiac MRI (Figure 2) confirmed that the proximal segment of the right coronary artery passed between the aorta and pulmonary artery and indicated that the origin was acutely angulated.

An association between this rare coronary anomaly and sudden cardiac death has been reported. It has been proposed that the oblique insertion of the right coronary artery and its upright, slit-like origin in such cases may cause intermittent obstruction to right coronary flow, particularly when the aorta and pulmonary trunk dilate during stress. The clinical details in this case are consistent with the hypothesis that malignant ventricular arrhythmias may be triggered by acute myocardial ischemia in the right coronary territory in the presence of this anomaly. The patient underwent a single vein graft to the right coronary artery performed off bypass, and she was well at last follow-up.
Sudden Death Related to an Anomalous Origin of the Right Coronary Artery
Florence Boissier, MD, Nathalie Coolen, MD, Patrick Nataf, MD, and Didier Tchetche, MD

Departments of Cardiothoracic Surgery and Cardiology, Hôpital Bichat-Claude Bernard, Assistance Publique—Hôpitaux de Paris and Université Denis Diderot-Paris 7, Paris, France

Nonatherosclerotic anomalies of the coronary arteries are not rare. They account for a third of sudden cardiac deaths in young patients. We report a case of resuscitated cardiac arrest due to an abnormal origin of the right coronary artery. Subsequently, coronary bypass grafting was carried out successfully. After resuscitated sudden death, there is no consensus on the diagnosis or therapeutic management of patients with abnormal coronary arteries.

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Anomalous Origin and Course of the Right Coronary Artery

Emiliano Antonio Maresi, MD; Antonina Maria Argo, MD; Giovanni Paolo Spanò MD; Giuseppina Maria Novo, MD; Daniela Rosaria Cabibi, MD; Paolo Giuseppe Procaccianti, MD
Considerations

- ARCA may result in SD first sign
- Anxiety of family
- Media attention
- Potential liability
- Sedentary lifestyle
Surgical unroofing

- Can be performed safely
- Do not dissect out coronary
- Open high on aorta
- Avoid taking down too much commissure
- Partial sternotomy
AAOCA

Consideration for repair

• Ectopic LM or LAD from Rt + intraarterial course
• Ectopic RCA from Lt + intraarterial course
  • More critical assessment since most are benign
  • Typical angina or ischemia

Age should be a factor in decision making

If treatment is declined:
  1. Avoidance of strenuous physical activity
  2. Abstinence from competitive athletics
Obesity in USA
No surgery

- No intramural portion
- Nondominant RCA
- Older ARCA without symptoms
Transeptal

- LM or LAD runs into the septum (subpulmonic); *intramyocardial course*
- often gives rise to septal perforators before it’s epicardial location
- Reports of sudden death
Post bypass, LITA - 3 ml/min, attributable to competitive flow from LM

Narrowing of left main to get LITA flow >15 ml/min, (appropriate to allow LITA to mature)