CORONARY ARTERY DISEASE SCREENING IN AIRCREW MEMBERS: A FRENCH RETROSPECTIVE STUDY

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I have no financial relationships to disclose.

I will not discuss off-label use and/or investigational use in my presentation.

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INTRODUCTION

Pilot suffers heart attack at Glasgow airport as he prepares to take off with 128 aboard

KLM captain on Amsterdam route was resuscitated by crew and a passenger after becoming unwell while heading for runway.

If both pilots of an airplane were to die of simultaneous heart attacks, could the autopilot prevent a crash?

Quora
METHODS

Aims of the study:

- To describe the population of AM with a CAD
- To evaluate the differences according to the clinical presentation (myocardial infarction, moderate symptoms, screening)
METHODS

Included population:

- Aircrew members examined in the AeMC of Clamart between 2010 and 2015
- History of coronary artery disease

86,691 files

Could be previous to 2010
METHODOLOGY

Analyzed Data:
- Age, sex, BMI, flight duty
- Cardio-vascular risk factors and SCORE risk
- Diagnosis, treatment, sequelae
- Fitness assessment
RESULTS AND DISCUSSION

• 120 AM with CAD:
  • Mean age: 53.2+/−8.9yo
  • 98.3% males
  • 79.2% civilians
  • BMI: 26.7+/−3.1kg/m²

Incidence: 88 cases per 100,000 AM per year (vs 400/100,000/y in French general population)
# CARDIOVASCULAR RISK

<table>
<thead>
<tr>
<th>CVRF</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>81(67.5)</td>
</tr>
<tr>
<td>Tobacco use</td>
<td>49(40.8)</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>49(40.8)</td>
</tr>
<tr>
<td>Family history</td>
<td>31(25.8)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>30(25)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7(5.8)</td>
</tr>
<tr>
<td>Obesity</td>
<td>18(15)</td>
</tr>
<tr>
<td>Sedentarity</td>
<td>16(13.3)</td>
</tr>
</tbody>
</table>

87% with 2 or more CVRF

**SCORE risk**

- < 1: low risk
- 1 à 5: moderated risk
- > 5: high risk
Clinical presentation

- Myocardial infarction: 66 cases (55%)
- Moderate symptoms: 28 cases (23%)
- Increased CVR: 19 cases (16%)
- Systematic ECG: 7 cases (6%)

- Including 2 pilots with in-flight events: 62% of them during physical activities

- Premature ventricular beats: n=3
- Abnormal repolarization: n=2
- LBBB
- Necrosis sequelae
DIAGNOSIS

- Exercise test: 14 (moderated symptoms n=28), 13
- Scintigraphy: 4, 5, 5, 2
- CT scan: 1, 5
- Coronarography: 28 (CVR n= 19), 7

- Systematic ECG: n=7
Moderate symptoms
n=28

CT scan
- Coronaro graphy 4%

Exercise ECG
- Coronaro graphy 50%
- Scintigraphy 7%

Scintigraphy

Coronaro graphy
- Coronaro graphy 10%

Coronaro graphy
- Coronaro graphy 36%
Abnormal ECG
n=7

57%

Exercise ECG
n=4

14%

Scintigraphy
n=1

Coronaryography
n=2

29%

14%

Scintigraphy
n=1

Coronaryography

Coronaryography
CVR
n=19

CT scan
Coronaro graphy

Exercise ECG
Scintigraphy

Coronaro graphy

Coronaro graphy

Coronaro graphy

20%
74%
26%
48%
6%
**DIAGNOSIS**

- **Monotronicular**: 25%
- **Bitronicular**: 48%
- **Trionicular**: 27%

**Chart Information:**

- LMCA: Left main coronary artery
- LCX: Left circumflex artery
- LAD: Left anterior descending artery
- RCA: Right coronary artery

- LMCA: 4%
- LCX: 55%
- LAD: 67%
- RCA: 53%
DIAGNOSIS
- LCA (4%)
- LCX (20%)
- LAD (16%)
- RCA (15%)
TREATMENT AND FITNESS ASSESSMENT

- 74% treated by percutaneous coronary intervention
  - 2 or more stents for 45% of the population

- 71% declared fit:
  - Time limitation 91%
  - Multi pilot limitation 81%
- 29% declared unfit
# CLINICAL PRESENTATION

<table>
<thead>
<tr>
<th></th>
<th>Myocardial infarction (n=66)</th>
<th>Moderate symptoms (n=28)</th>
<th>No symptom (n=26)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
<td>27.06 ± 3.19</td>
<td>26.32 ± 3.12</td>
<td>26.30 ± 3.01</td>
<td>NS</td>
</tr>
<tr>
<td>Age (yo)</td>
<td>51.11 ± 8.03</td>
<td>53.86 ± 10.39</td>
<td>57.58 ± 7.98</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>number of CVRF</td>
<td>2.03 ± 1.09</td>
<td>2 ± 1.09</td>
<td>2.31 ± 1.09</td>
<td>NS</td>
</tr>
<tr>
<td>SCORE CV risk</td>
<td>1.52 ± 1.20</td>
<td>1.75 ± 2.40</td>
<td>3.64 ± 3.58</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Period between diagnosis and decision (months)</td>
<td>25.06 ± 36.9</td>
<td>23.71 ± 27.86</td>
<td>10.92 ± 4.92</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>
**CLINICAL PRESENTATION**

<table>
<thead>
<tr>
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<th>Myocardial infarction (n=66)</th>
<th>Moderate symptoms (n=28)</th>
<th>No symptom (n=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary lesion</td>
<td>LCX</td>
<td>30 (46.9%)</td>
<td>13 (46.3%)</td>
</tr>
<tr>
<td>Treatment</td>
<td>Bypass</td>
<td>4 (6.1%)</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>Investigations</td>
<td>Normal TTE</td>
<td>26 (39.4%)</td>
<td>21 (75%)</td>
</tr>
</tbody>
</table>

No significant difference for:
- crew duty
- civilian/military status
- **fitness decision**...
CAD SCREENING IN ASYMPTOMATIC AIRCREW MEMBERS
MED.B.010 Cardiovascular System

(a) Examination

(1) A standard 12-lead resting electrocardiogram (ECG) and report shall be completed on clinical indication and:

(i) for a Class 1 medical certificate, at the examination for the first issue of a medical certificate, then every 5 years until age 30, every 2 years until age 40, annually until age 50, and at all revalidation or renewal examinations thereafter;

(ii) for a Class 2 medical certificate, at the first examination after age 40 and then every 2 years after age 50.

(2) Extended cardiovascular assessment shall be required when clinically indicated.

(3) For a Class 1 medical certificate, an extended cardiovascular assessment shall be completed at the first revalidation or renewal examination after age 65 and every 4 years thereafter.

(4) For a Class 1 medical certificate, estimation of serum lipids, including cholesterol, shall be required at the examination for the first issue of a medical certificate, and at the first examination after having reached the age of 40.
CAD SCREENING: CV RISK

• Importance of interrogatory and clinical examination

• Blood tests

• Evaluation of the CV risk

- Family history
- Tobacco use
- Hypertension
- Sedentarity
- Obesity
- Sleep apnea...

- Diabetes
- Cholesterol
<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>In asymptomatic adults with hypertension or diabetes a resting ECG should be considered for CV risk assessment.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>In asymptomatic adults at intermediate risk (see SCORE for definition of intermediate risk - <a href="http://www.heartscore.org">www.heartscore.org</a>) measurement of carotid intima-media thickness with screening for atherosclerotic plaques by carotid ultrasound, measurement of ankle-brachial index or measurement of coronary calcium using CT should be considered for CV risk assessment.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>In asymptomatic adults with diabetes, 40 years of age and older, measurement of coronary calcium using CT may be considered for CV risk assessment.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>In asymptomatic adults without hypertension or diabetes a resting ECG may be considered.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>In intermediate-risk asymptomatic adults (see SCORE for definition of intermediate risk - <a href="http://www.heartscore.org">www.heartscore.org</a>), (including sedentary adults considering starting a vigorous exercise programme), an exercise ECG may be considered for CV risk assessment particularly when attention is paid to non-ECG markers such as exercise capacity.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>In asymptomatic adults with diabetes or asymptomatic adults with a strong family history of CAD or when previous risk assessment testing suggests high risk of CAD, such as a coronary artery calcium score of 400 or greater stress imaging tests (MPI, stress echocardiography, perfusion CMR) may be considered for advanced CV risk assessment.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>In low- or intermediate-risk (based on SCORE) asymptomatic adults stress imaging tests are not indicated for further CV risk assessment.</td>
<td>III</td>
<td>C</td>
</tr>
</tbody>
</table>

ESC Guidelines SCAD 2013, European Heart Journal, 2013
CAD SCREENING

- Non invasive cardiological tests?
  - Exercise ECG
  - MSCT
  - MRI

For what population?
- Only for high or moderate CV risk?
- Abnormal ECG
- Everybody over 40yo?
<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise ECG</td>
<td>45–50</td>
<td>85–90</td>
</tr>
<tr>
<td>Exercise stress echocardiography</td>
<td>80–85</td>
<td>80–88</td>
</tr>
<tr>
<td>Exercise stress SPECT</td>
<td>73–92</td>
<td>63–87</td>
</tr>
<tr>
<td>Dobutamine stress echocardiography</td>
<td>79–83</td>
<td>82–86</td>
</tr>
<tr>
<td>Dobutamine stress MRI</td>
<td>79–88</td>
<td>81–91</td>
</tr>
<tr>
<td>Vasodilator stress echocardiography</td>
<td>72–79</td>
<td>92–95</td>
</tr>
<tr>
<td>Vasodilator stress SPECT</td>
<td>90–91</td>
<td>75–84</td>
</tr>
<tr>
<td>Vasodilator stress MRI</td>
<td>67–94</td>
<td>61–85</td>
</tr>
<tr>
<td>Coronary CTA</td>
<td>95–99</td>
<td>64–83</td>
</tr>
<tr>
<td>Vasodilator stress PET</td>
<td>81–97</td>
<td>74–91</td>
</tr>
</tbody>
</table>
PROVISIONNAL DECISION TREE

- Acquired LBBB
  - Clinical examination & Cardiac risk assessment (SCORE; Framingham...)
  - 

- Low risk
  - Exercise test / EchoCardiology / EKG Holter: search cues for a CAD, for another particular etiology (specific exams can be required / fitness assessment) and for higher conduction disorders

- Moderate to high risk

  - MSCT
    - Suspected CAD

    - Normal
      - According to precise duty consider other investigations... i.e. electrophysiology

    - Abnormal (treatment...)
      - Aeromedical decision according to national policy, aircrew duty & position

  - ICA +/- scintigraphy

Cited in:
- Current indications for cardiac CT 2009 *Journal de Radiologie* 90 (9 C2), pp. 1123-1132
- Current indications for cardiac CT 2009 *Archives of Cardiovascular Diseases Supplements* 1 (1), pp. 13-22
- Cardiac computed tomography: Indications, applications, limitations, and training requirements - Report of a Writing Group deployed by the Working Group Nuclear Cardiology and Cardiac CT of the European Society of Cardiology and the European Council of Nuclear Cardiology 2008 *European Heart Journal* 29 (4), pp. 531-556
Schwitter et al EHJ 2013, JCMR 2012
MAIN FEATURES OF AM WITH CAD

- Presentation: myocardial infarction (55%)
- CVR: low or moderate (93%)
- At least 2 CVRF (especially age, smoking, dyslipidemia)
- Bi or triconcacular lesions (52%)
- >1/3 with lesion on proximal LAD or LMCA
- Treated with PCI (≥ 2 stents in 45% of cases)
- Declared fit (71%), multi pilot limitation (81%)
CONCLUSION

• 55% of AM with myocardial infarction

⇒ Improvement of CAD screening is necessary
  ▪ CV risk evaluation
  ▪ Resting ECG
  ▪ Exercise ECG remains useful
  ▪ MSCT: CAD screening when low risk
  ▪ Stress MRI : CAD screening when moderate or high risk

• Prevention remains essential

⇒ Interest of the coronary calcium score