Difficulties in aeromedical decision making in an unusual case of hypercoagulopathy and vasculopathy

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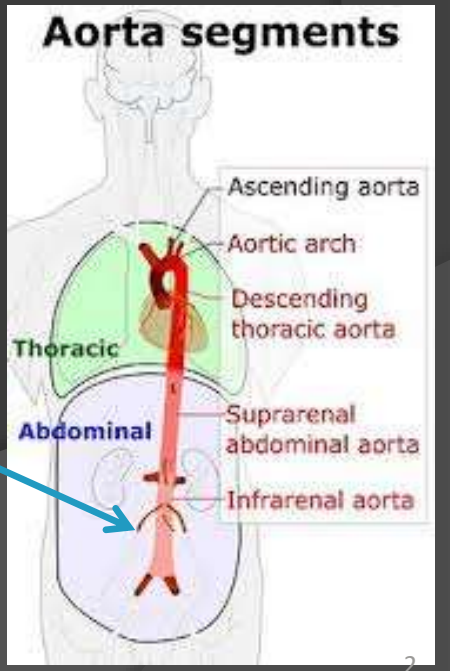
Presentation

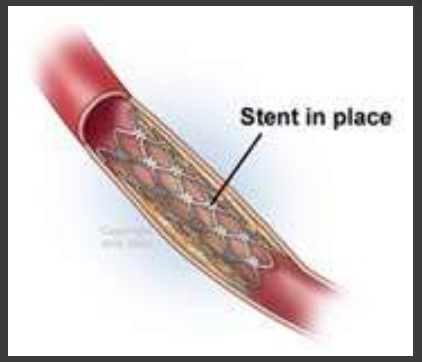
- 42 Male airline pilot >10,000h flying
- Smoker 20 years, hyperlipidemia
- Family h/o Stroke
- Jan 2015 - pain, swelling, discoloration ® toe, claudication
- Doppler/ CT Angiography – stenosis at bifurcation of abdominal aorta, less flow ® leg

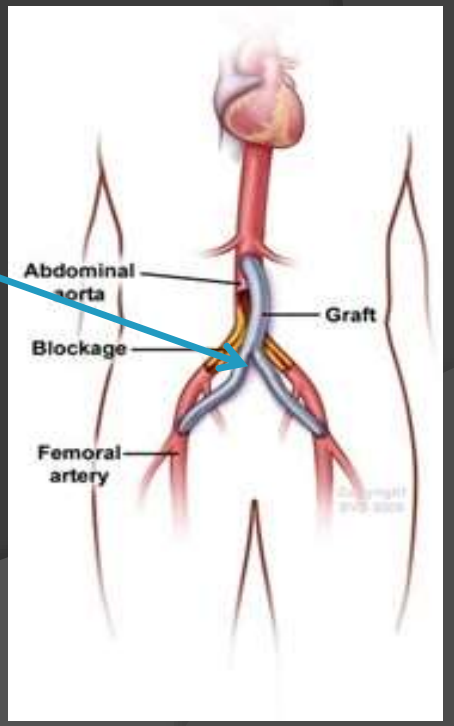


https://en.m.wikipedia.org/wiki/Aorta

Treatment

- Bilateral aorto-iliac stenting (kissing stents)
- Tab Clopidogrel, Ecosprin
- Restenosis in 6 months
- Aorto-bi-iliac bypass, graft arterectomy, ® iliac anastamosis
- Hemoperitoneum on day 2
- Warfarin, Rosuvastatin 10mg Finofibrate 160mg





https://vascular.surgery.ucsf.edu/conditions--procedures/lower-extremity-bypass-surgery.aspx

Warfarin

Date	Dose	INR range
Jan 2016 (post-op)	7 mg/day	2-3
Dec 2016	2 mg/day	2-3
Since Jan 2017	2 mg on 4 days, 1 mg on 3 days	2-3

Regulatory perspective

- **Hypercoagulability profile**
  - Protein S activity
  - Protein C activity - ↑
  - Anti-Thrombin III activity
  - Activated Protein C resistance
  - Cardiolipin antibody ACL IgM/G
  - Lupus anticoagulant profile
  - Flow cytometric immuno phenotyping for paroxysmal nocturnal hemoglobinuria

Regulatory perspective

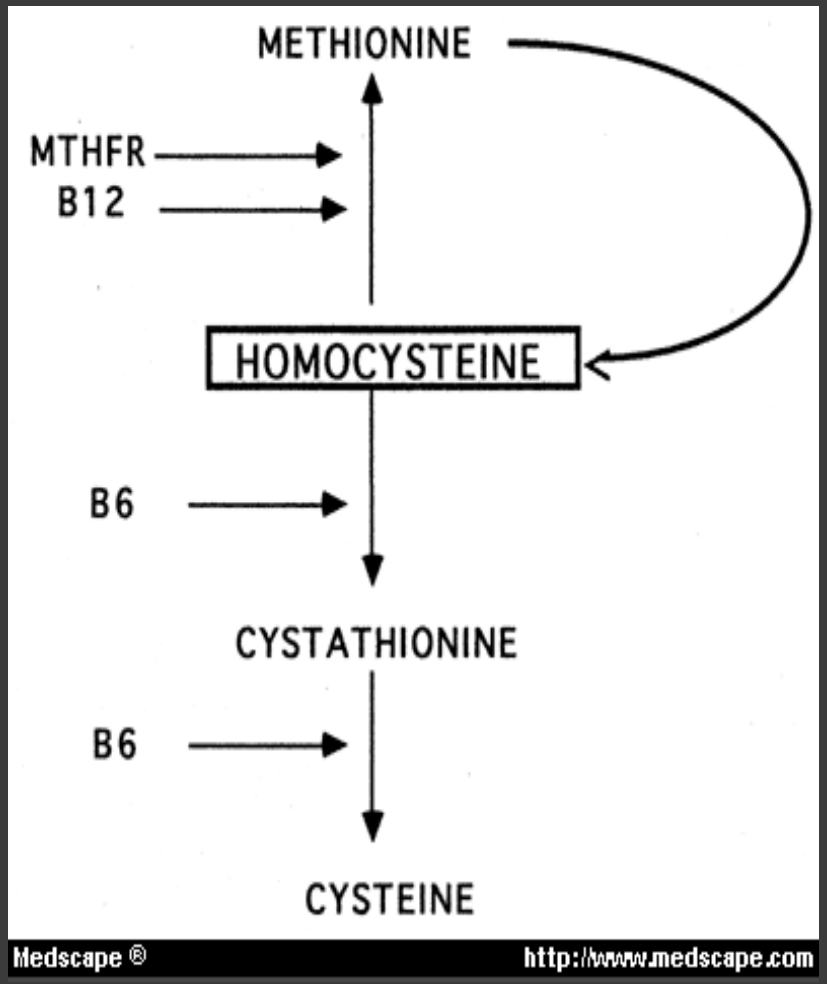
- **Hypercoagulability profile**
  - Phospholipid IgG/ IgM
  - β-2 glycoprotein IgG/ IgM
  - CCP Antibody cyclic citrullinated peptide
  - C-Reactive Protein
  - T3, T4, TSH
  - Complete Blood Count
  - Serum Lipids
  - Rheumatoid test

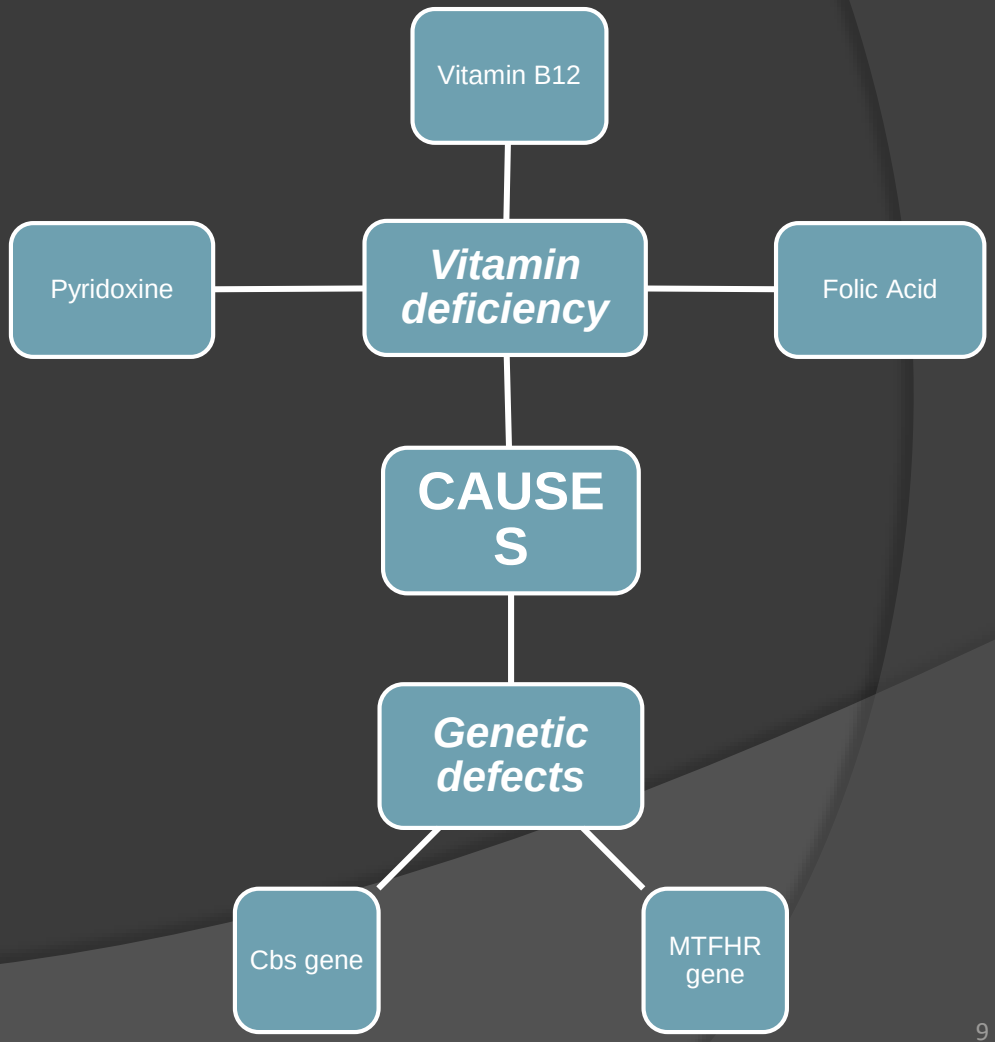
Regulatory perspective

- **Hypercoagulability profile**
  - Bleeding time, Clotting time, Prothrombin time
  - Homocystine – 23μmol/L
  - Anti nuclear antibody – weakly positive
  - MTHFR C677T mutation
  - Factor II (G20210A) mutation
  - MTHFR A 1298C mutation – Detected (Heterozygous)

Hyperhomocystinemia

- Homocystine – small sulfur-containing amino acid
- Normal – 5-15μmol/L

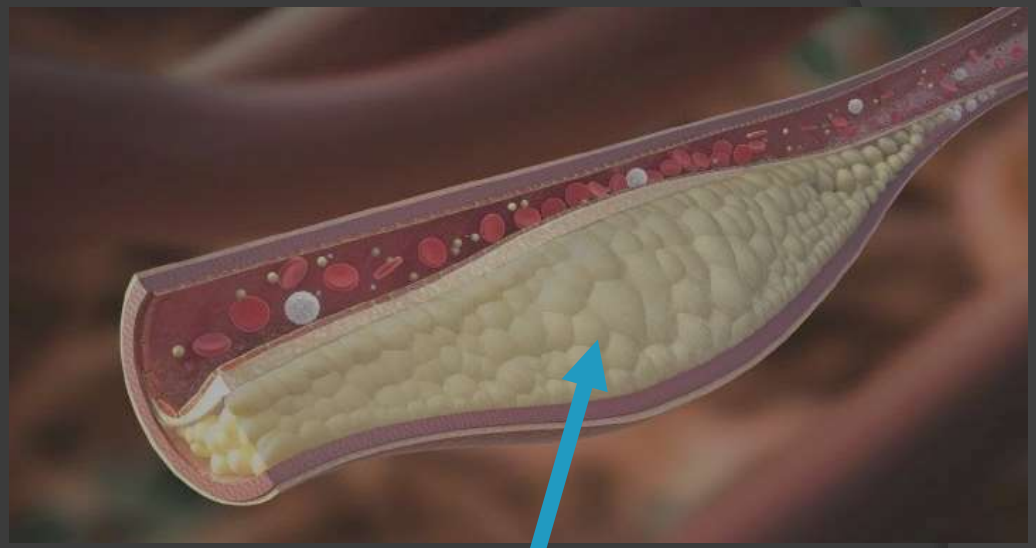




https://www.medscape.com/viewarticle/559684

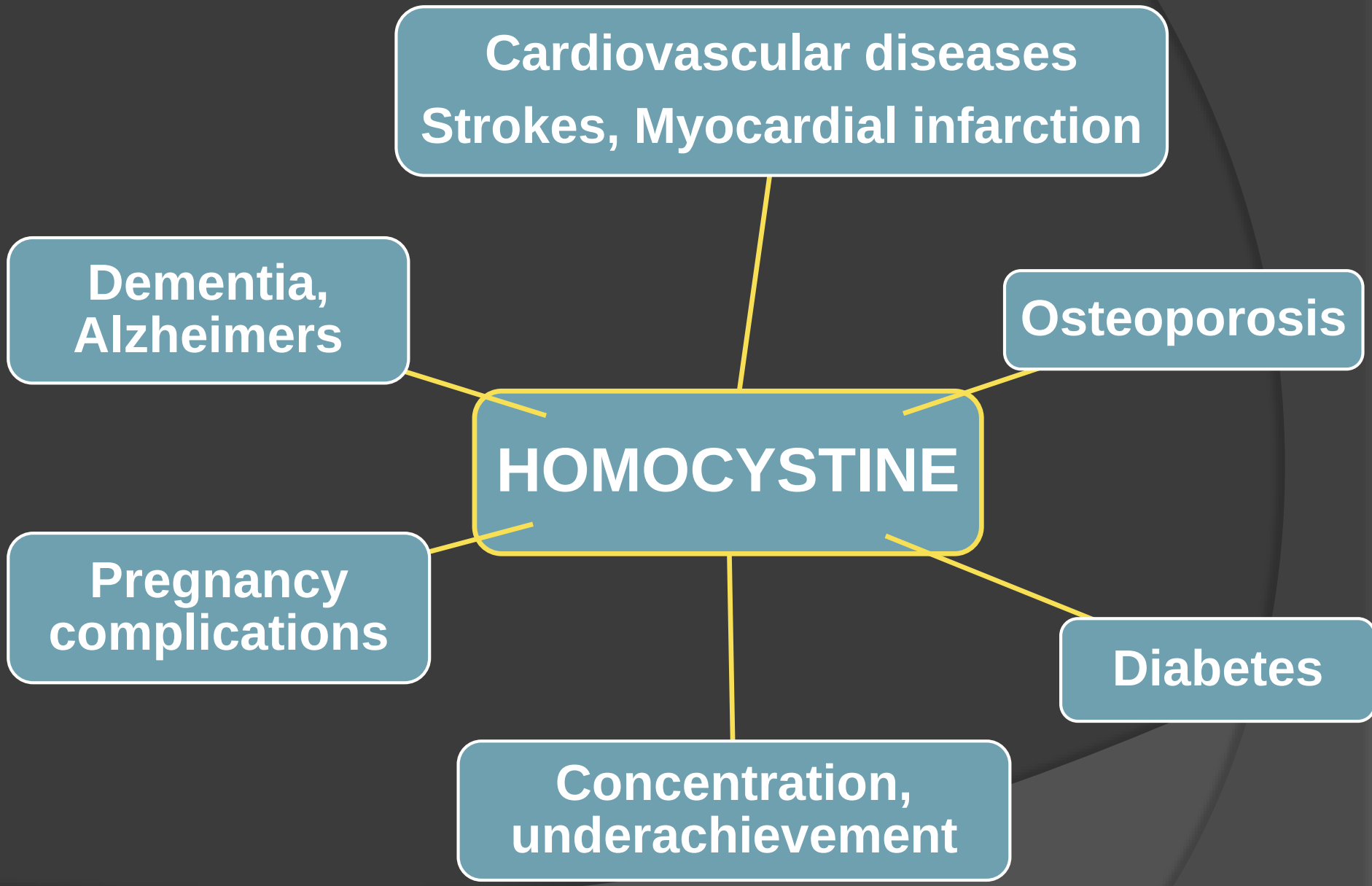
Hyperhomocystinemia

- Pathophysiology



Endothelial cell damage precipitating thrombus formation

http://www.healthgala.info/2017/05/Hyperhomocysteinemia-ICD-10-Definition-Symptoms-Causes-Complications-Treatment.html


Cardiovascular diseases
Strokes, Myocardial infarction
Dementia, Alzheimers
Osteoporosis
HOMOCYSTINE
Pregnancy complications
Diabetes
Concentration, underachievement

Will you let him fly??

Aeromedical Decision Making (ADM) algorithm (Navathe et al)

Diagnosis

⇓

1. **Likelihood of medical incapacitation**

⇓

2. **Likelihood of unacceptable outcome in flight**

⇓

3. **Risk acceptable**

⇓

4. **Risk after likelihood modification**

⇓

5. **Manage consequences**

⇓

Risk acceptable after consequence modification

ADM algorithm

Diagnosis

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Risk acceptable after consequence modification

Aeromedical Decision Making

- **Diagnosis**
  - Peripheral Vascular Disease
  - Thrombosis associated iliac artery stenosis
  - Hyperhomocystinemia
  - MTHFR A 1298C mutation

ADM algorithm

Diagnosis

⇓

1. **Likelihood of medical incapacitation**

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2. Likelihood of unacceptable outcome in flight

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Risk acceptable after consequence modification

Aeromedical Decision Making

1. **Likelihood of medical incapacitation (due to the diagnosis and treatment)**
   - Tendency to thrombus formation
   - Risk of GI or cerebral bleed

   - *Coronary Angiography, TMT and carotid artery doppler normal, colour doppler lower limbs shows less flow to ® leg*

ADM algorithm

Diagnosis

⇓

1. Likelihood of medical incapacitation

⇓

2. **Likelihood of unacceptable outcome in flight**

⇓

3. Risk acceptable

⇓

4. Risk after likelihood modification

⇓

5. Manage consequences

⇓

Risk acceptable after consequence modification

Aeromedical Decision Making

2. **Likelihood of unacceptable outcome in flight**
   - Distracting pain due to bleed
   - Loss of consciousness due to bleed
   - Variable diet control, difficulty in monitoring INR may increase chances of bleed while flying

http://www.traveller.com.au/doctors-on-board-planes-what-happens-when-theres-a-medical-emergency-on-a-flight-gtpvri

ADM algorithm

Diagnosis

⇓

1. Likelihood of medical incapacitation

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2. Likelihood of unacceptable outcome in flight

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⇓

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⇓

Risk acceptable after consequence modification

Aeromedical Decision Making

3. Risk acceptable

- **Apparently No**

- **Yes, if**:

✓ Underlying condition adequately controlled

✓ Strict Warfarin compliance

✓ INRs maintained satisfactorily

ADM algorithm

Diagnosis

⇓

1. Likelihood of medical incapacitation

⇓

2. Likelihood of unacceptable outcome in flight

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3. Risk acceptable

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⇓

5. Manage consequences

⇓

Risk acceptable after consequence modification

Aeromedical Decision Making

4. **Risk after likelihood modification**
   - Peripheral Vascular Disease – Stop smoking
   - Thrombosis associated iliac artery stenosis – Control Lipids
   - Hyperhomocystinemia – Adequately treat and monitor
   - MTHFR A 1298C mutation

Aeromedical Decision Making

4. **Risk after likelihood modification**
   - Tendency to thrombus formation – Strict warfarin compliance
   - Risk of GI or cerebral bleed – Maintain INRs

https://www.shutterstock.com/search/brain%2Bbleed?page=3&searchterm=brain%20bleed&search_source=base_related_searches&language=en&noid=1

Aeromedical Decision Making

4. **Risk after likelihood modification**
   - Distracting pain due to GI or cerebral bleed
   - Loss of consciousness
   - Variable diet, difficulty monitoring INR may increase bleeding while flying
   - Warfarin compliance and monitoring
   - Permanent diet changes
   - Maintain INRs at acceptable levels
   - Possible? $\rightarrow$Yes

Warfarin vs DOACs

- Disadvantages of DOACs
  - Standard scheduled fixed dose – *sub or supra therapeutic dosage*
  - Close monitoring not done
  - Strict INR maintaining dicey
  - Risk of thrombus formation or bleed higher

Warfarin vs Anti-platelets

- Etiology – thrombus associated stenosis
- Risk of recurrence high
- Demonstrated clinical necessity

- **WARFARIN life long…!**

Aeromedical Decision Making

4. Risk after likelihood modification

- INR clinical target range – 2 to 3

4. Risk after likelihood modification

INR target ranges for fitness (regulatory)

Aviation Authority	Minimum observation	Periodicity	INR Range
FAA	6 weeks	Earlier weekly, then monthly	Last 6 INRs in therapeutic range

4. Risk after likelihood modification

INR target ranges for fitness

Aviation Authority	Minimum observation	Periodicity	INR Range
FAA	6 weeks	Earlier weekly, then monthly	Last 6 INRs in therapeutic range
EASA	**6 months**	**2 monthly, 12 h prior**	**Therapeutic range**

4. Risk after likelihood modification

INR target ranges for fitness

Aviation Authority	Minimum observation	Periodicity	INR Range
FAA	6 weeks	Earlier weekly, then monthly	Last 6 INRs in therapeutic range
EASA	**6 months**	**2 monthly, 12 h prior**	**Therapeutic range**
CASA		Earlier weekly, then monthly	Last 3 INRs: 1.4 to 4.0

4. Risk after likelihood modification

INR target ranges for fitness

Aviation Authority	Minimum observation	Periodicity	INR Range
FAA	6 weeks	Earlier weekly, then monthly	Last 6 INRs in therapeutic range
EASA	**6 months**	**2 monthly, 12 h prior**	**Therapeutic range**
CASA		Earlier weekly, then monthly	Last 3 INRs: 1.4 to 4.0
CAA NZ		**Monthly & 1 within 10 days prior**	**2 to 3 or 2.5 to 3.5**

ADM algorithm

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5. **Manage consequences**

⇓

Risk acceptable after consequence modification

Aeromedical Decision Making

5. Manage consequences

- 1 YEAR symptom free with acceptable INRs
- Multicrew limitation
- Validity – 6 monthly/ 1 year
- Surveillance –

Aeromedical Decision Making

5. Manage consequences

- Surveillance –

Test	Frequency
INR	Monthly
Homocystine levels	3 monthly
S. Lipids	6 monthly
Colour doppler lower limbs	6 monthly

Aeromedical Decision Making

5. Manage consequences

- Surveillance –

Test	Frequency
ABI Stress test lower limbs	6 monthly
TMT	Annual
Carotid artery doppler	2 yearly

ADM algorithm

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5. Manage consequences

⇓

Risk acceptable after consequence modification

Aeromedical Decision Making

- **Risk acceptable after consequence modification**

YES 

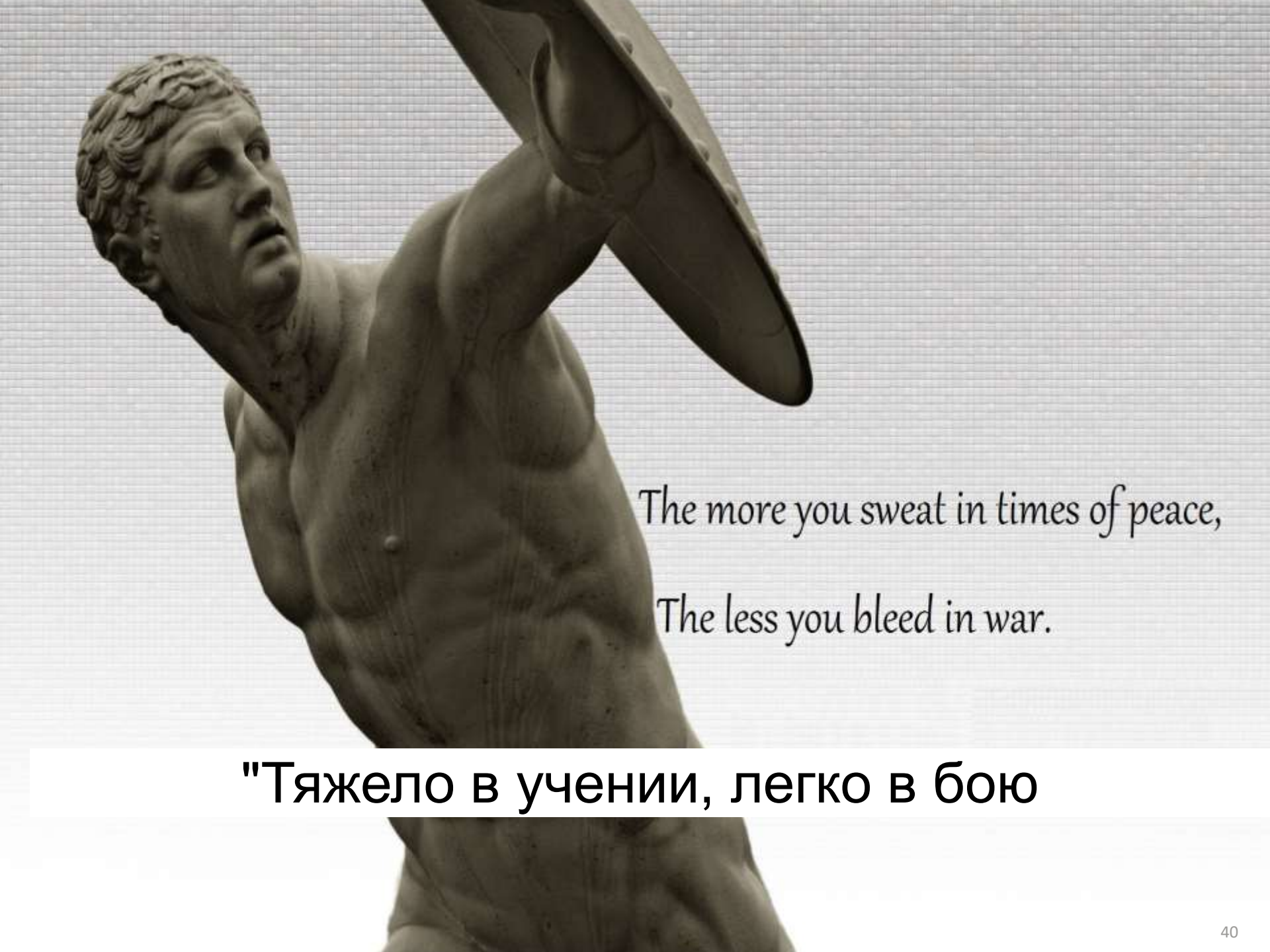
ELIGIBLE TO FLY

NO 

Manage Consequences

? Underlying condition not acceptable

Will you let him fly??



"Тяжело в учении, легко в бою