Diabetes Mellitus
Aeromedical Considerations

Aviation Medicine Seminar
Bucharest, Romania.
11th to 15th November 2013
Applicants with metabolic, nutritional or endocrine disorders that are likely to interfere with the safe exercise of their licence and rating privileges shall be assessed as unfit.

Applicants with insulin treated diabetes mellitus shall be assessed as unfit.

Note.— Guidance on assessment of Type 2 insulin-treated diabetic applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine (Doc 8984).
Diabetes:

Applicants with non insulin treated diabetes shall be assessed as unfit unless the condition is shown to be satisfactorily controlled by diet alone or by diet combined with oral anti-diabetic medication, the use of which is compatible with the safe exercise of the applicant’s licence and rating privileges.

Diabetes: Key facts

- 347 million people worldwide have diabetes*.

- In 2004, an estimated 3.4 million people died from consequences of high fasting blood sugar.

- More than 80% of diabetes deaths occur in low- and middle-income countries.

- WHO projects that diabetes will be the 7th leading cause of death in 2030.

- Healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco use can prevent or delay the onset of type 2 diabetes.

(* Definition of diabetes used for the estimates: fasting glucose >= 7.0 mmol/L or on medication.)
Diabetes: Data and statistics

The number of people with diabetes in the European Region: **60 million**
What is diabetes?

Diabetes is a chronic disease that occurs either

- when the pancreas does not produce enough insulin or
- when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar.

Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels.
Type 1 diabetes

Type 1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset) is characterized by deficient insulin production and requires daily administration of insulin. The cause of type 1 diabetes is not known and it is not preventable with current knowledge.

Symptoms include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes and fatigue. These symptoms may occur suddenly.
Type 2 diabetes

Type 2 diabetes (formerly called non-insulin-dependent or adult-onset) results from the body’s ineffective use of insulin. Type 2 diabetes comprises 90% of people with diabetes around the world, and is largely the result of excess body weight and physical inactivity.

Symptoms may be similar to those of Type 1 diabetes, but are often less marked. As a result, the disease may be diagnosed several years after onset, once complications have already arisen. Effects develop 5-10yr pre-diagnosis.

Until recently, this type of diabetes was seen only in adults but it is now also occurring in children.
Gestational diabetes

Gestational diabetes is hyperglycaemia with onset or first recognition during pregnancy. Symptoms of gestational diabetes are similar to Type 2 diabetes. Gestational diabetes is most often diagnosed through prenatal screening, rather than reported symptoms.

Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG)

Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) are intermediate conditions in the transition between normality and diabetes. People with IGT or IFG are at high risk of progressing to type 2 diabetes, although this is not inevitable.
### Diabetes mellitus diagnostic criteria

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<th><strong>Diabetes</strong></th>
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<tr>
<td>Fasting plasma glucose</td>
<td>$\geq 7.0$ mmol/l (126 mg/dl)</td>
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<tr>
<td>2–h plasma glucose*</td>
<td>or</td>
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<td>$\geq 11.1$ mmol/l (200 mg/dl)</td>
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<tr>
<th><strong>Impaired Glucose Tolerance (IGT)</strong></th>
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<tr>
<td>Fasting plasma glucose</td>
<td>$&lt; 7.0$ mmol/l (126 mg/dl)</td>
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<tr>
<td>2–h plasma glucose*</td>
<td>and</td>
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<td>$\geq 7.8$ and $&lt; 11.1$ mmol/l</td>
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<td>(140 mg/dl and 200 mg/dl)</td>
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<th><strong>Impaired Fasting Glucose (IFG)</strong></th>
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<tr>
<td>Fasting plasma glucose</td>
<td>6.1 to 6.9 mmol/l</td>
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<tr>
<td>2–h plasma glucose*</td>
<td>(110 mg/dl to 125 mg/dl)</td>
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<td>and (if measured)</td>
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<td></td>
<td>$&lt; 7.8$ mmol/l (140 mg/dl)</td>
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* Venous plasma glucose 2–h after ingestion of 75g oral glucose load

* If 2–h plasma glucose is not measured, status is uncertain as diabetes or IGT cannot be excluded

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**Table 1: 2006 WHO recommendations for the diagnostic criteria for diabetes and intermediate hyperglycaemia.**

*Source: www.who.int/diabetes*
What are common consequences of diabetes?

Over time, diabetes can damage the heart, blood vessels, eyes, kidneys, and nerves. Diabetes increases the risk of heart disease and stroke. 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke). Combined with reduced blood flow, neuropathy (nerve damage) in the feet increases the chance of foot ulcers, infection and eventual need for limb amputation. Diabetic retinopathy is an important cause of blindness, and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. One percent of global blindness can be attributed to diabetes. Diabetes is among the leading causes of kidney failure. The overall risk of dying among people with diabetes is at least double the risk of their peers without diabetes.
Diabetes mellitus

• Intrinsic risks of aeromedical relevance
  ➢ Untreated or poorly controlled DM
  ➢ Coronary artery disease
  ➢ Hypertension
  ➢ Diabetic complications
    ✓ Retinopathy
    ✓ Peripheral neuropathy
    ✓ Nephropathy
Diabetes mellitus

• Extrinsic risks of aeromedical relevance
  ➢ Hypoglycemia
    ✓ iatrogenic
    ✓ Sudden or insidious incapacitation
    ✓ Up to 36% of individuals who experienced severe hypoglycemia do not have any warning symptoms
    ✓ Performance degradation with task complexity
    ✓ Reaction times do not return to baseline 20-30 minutes after restoration of euglycemia
Diabetes mellitus

- Principles of management
  - Optimise blood glucose control but avoid aggressive glucose lowering
  - Reduce incidence of micro- and macrovascular complications
  - Pharmacological treatment does not substitute lifestyle modification measures
  - Motivation and compliance are enablers to optimal diabetes control and retention in aviation duties
Diabetes mellitus

• Targets of satisfactory control for aviation duties
  ➢ BMI < 25 kg/m\(^2\)
  ➢ Blood pressure < 140/90 mmHg
  ➢ HbA1c < 7%
  ➢ Fasting blood glucose < 6.7 mmol/L
  ➢ Fasting lipid profile within target treatment range for high cardiovascular risk group
Diabetes mellitus treatment

- **Compatible with aviation duties**
  - Lifestyle modification measures
  - Metformin
  - Thiazolidinediones*
  - DPP4 inhibitors*
  - Alpha-glucosidase inhibitors

- **Incompatible / used with caution in aircrew**
  - Sulphonylureas
  - Meglitinides
  - Insulin

*To be reviewed if used in combination with another class of oral hypoglycemic agent due to potentiating effects for hypoglycemia

European Diabetes Panel
UK CAA and EASA
27 & 28 Feb. 2014
How can the burden of diabetes be reduced? (remain licensable till retirement)

1. Prevention

Simple lifestyle measures have been shown to be effective in preventing or delaying the onset of type 2 diabetes.

To help prevent type 2 diabetes and its complications, people should:
- ✓ achieve and maintain healthy body weight;
- ✓ be physically active – at least 30 minutes of regular, moderate-intensity activity on most days.

More activity is required for weight control;
- ❄ eat a healthy diet of between three and five servings of fruit and vegetables a day and reduce sugar and saturated fats intake;
- ❄ avoid tobacco use – smoking increases the risk of cardiovascular disease.
1. Prevention (cont’d)

- Better diet
- Increased physical activity
- Modest weight loss

-> could reduce development of Type 2 DM in high risk middle aged adults by 58%

Finnish Diabetes Prevention Study, Finland
Diabetes Prevention Programme, USA
2. Early diagnosis and treatment

- Early diagnosis can be accomplished through relatively inexpensive blood testing.

- Treatment of diabetes involves lowering blood glucose and the levels of other known risk factors that damage blood vessels.

- Tobacco use cessation is also important to avoid complications.

Interventions that are both cost saving and feasible in developing countries include:
  - moderate blood glucose control. People with type 1 diabetes require insulin; people with type 2 diabetes can be treated with oral medication, but may also require insulin;
  - blood pressure control;
  - foot care.
World Diabetes Day raises global awareness of diabetes - its escalating rates around the world and how to prevent the illness in most cases.

Started by the International Diabetes Federation (IDF) and WHO, the Day is celebrated on 14 November to mark the birthday of Frederick Banting who, along with Charles Best, was instrumental in the discovery of insulin in 1922, a life-saving treatment for diabetes patients.
Thank you for your kind attention!

Jarnail Singh