Aeromedical Disposition of Diabetes in USAF Aviators

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Disclosure Statement

- The views expressed are those of the author and do not necessarily reflect the views of the United States Air Force or the United States Government.

- I have no relevant financial relationships to industry.
Overview

- Review of diabetes
  - Type 1 diabetes: insulin deficiency
  - Type 2 diabetes: insulin resistance
- Aeromedical considerations in diabetic aviators
  - Hyperglycemia
  - Micro- and macrovascular complications
  - Treatment-related hypoglycemia
- Aeromedical disposition of diabetes in USAF aviators
Type 1 Diabetes

- Absolute insulin deficiency
- Autoimmune pancreatic beta cell destruction
- Islet cell autoantibodies in ~85%
  - GAD, insulin, IA-2, ICA

- Patient demographic: young, thin
- 5-10% of diabetics in the U.S.
Type 1 Diabetes

- Uncontrolled hyperglycemia
  - Polyuria, polydipsia, polyphagia, fatigue, blurred vision, nausea, weight loss
  - Diabetic ketoacidosis

- Treatment: insulin
  - Hypoglycemia
  - Hypoglycemia unawareness
Type 2 Diabetes

- Multifactorial
  - Insulin resistance
  - Inadequate insulin secretion

- Diabetogenic lifestyle + susceptible genotype
  - 90% of type 2 diabetics are obese
  - 39% of type 2 diabetics have a diabetic parent

- Patient demographic: older, obese
Type 2 Diabetes

- Hyperglycemia
  - Polyuria, polydipsia, polyphagia, fatigue, blurred vision, nausea, weight loss
  - Asymptomatic
  - Not ketosis prone

- Complications
  - Nephropathy, retinopathy, neuropathy
  - Atherosclerotic disease: CAD, PAD, stroke
Diabetes: Diagnosis

- **Diabetes**
  - A1C $\geq 6.5\%$
  - FPG $\geq 126 \text{ mg/dL}$
  - Random PG with symptoms $\geq 200 \text{ mg/dL}$
  - Oral GTT $\geq 200 \text{ mg/dL}$

- **“Pre-diabetes”**
  - A1C 5.7% - 6.4%
  - IFG 100 - 125 mg/dL
  - IGT 140 - 199 mg/dL
Type 2 Diabetes: Treatment

- **Diet and exercise**: 1.0 – 2.0% ↓ A1C
- **Oral medication**
  - Metformin: 1.0 – 2.0%
  - Sulfonylureas: 1.0 – 2.0%
  - TZDs: 0.5 – 1.4%
  - Meglitinides: 0.5 – 1.5%
  - Alpha-glucosidase inhibitors: 0.5 – 0.8%
  - Incretins: 0.5 – 1.4%
  - Amylin: 0.5 – 1.0%
- **Insulin**: 1.5 – 3.5%
Diabetes: Treatment Goals

- A1C < 7%
- Preprandial glucose 90 – 130 mg/dL
- Postprandial glucose < 180 mg/dL
- Blood pressure < 130/80 mmHg
- LDL < 100 mg/dL
- TG < 150 mg/dL
- HDL > 40 mg/dL men, > 50 mg/dL women
**Diabetes: Treatment**

- Monitor annually for development of complications
  - Dilated retinal exam
  - Spot urine albumin-to-creatinine ratio
    - Microalbuminuria (30 – 300 mg/day), proteinuria (>300 mg/day)
  - Comprehensive foot exam
    - Visual inspection
    - Pedal pulses
    - Neurologic sensory testing (monofilament)
Aeromedical Concerns: Hyperglycemia

- Polyuria → distracting
- Fatigue → subtle decrement of function
- Blurred vision → safety of flight
- Severe hyperglycemia → incapacitating
  - Type 1 diabetics → diabetic ketoacidosis (DKA)
  - Type 2 diabetics → hyperosmolar hyperglycemic state (HHS)
Aeromedical Concerns: Microvascular Complications

- Neuropathy can limit sensory input
  - Subtle decrement of function
  - Distracting

- Retinopathy can lead to visual impairment
  - Safety of flight

- Nephropathy
  - Unlikely to be of aviation significance in the absence of electrolyte derangements
Aeromedical Concerns: Macrovascular Complications

- Increased risk of myocardial infarction
  - Sudden incapacitation

- Increased risk of stroke
  - Sudden incapacitation

- Increased risk of peripheral artery disease
  - Atypical leg pain in 40 to 50% of patients with PAD
  - Distracting
Aeromedical Concerns: Treatment-related Hypoglycemia

- Oral hypoglycemics
  - Insulin sensitizers – less likely to cause hypoglycemia
  - Insulin secretagogues – more likely to cause hypoglycemia

- Insulin
  - Hypoglycemia common
    - Two symptomatic episodes per week
    - One incapacitating episode per year
Aeromedical Concerns: Treatment-related Hypoglycemia

- Counter-regulation
  - Immediate – glucagon, catecholamines
  - Delayed – cortisol, growth hormone

- Hypoglycemia unawareness
  - Type 1 diabetes
  - Advanced type 2 diabetes
Diabetes: Disposition in USAF Aircrew

- Diabetes mellitus is disqualifying for USAF flying duties
  - Type 1 Diabetes: no waiver potential
    - Risk of hypoglycemia on insulin therapy
  - Type 2 Diabetes:
    - Diet control – unrestricted waiver possible
    - Metformin – may fly with another qualified pilot
      - Reviewing data to consider unrestricted waiver in the future
    - Sitagliptin
      - Currently not approved, but under consideration for possible waiver in the future
      - Hypoglycemia unlikely
Type 2 Diabetes Waiver

Data reviewed for waiver

- Glucose control (HbA1C, fasting blood glucose)
- Renal function (metabolic panel for estimated GFR, spot urine albumin:creatinine)
- Foot exam, including monofilament testing
- Dilated eye exam to evaluate for retinopathy
- Lipid panel
- Blood pressure
- ECG
Type 2 Diabetes Waiver

- Treated with diet/weight loss or metformin
- Must be under good control
  - Fasting blood glucose < 126 mg/dl
  - Hgb A1C < 7%
  - Lipid panel targeted to NCEP guidelines, currently LDL < 100 mg/dL
  - Blood pressure controlled to JNC guidelines, currently < 130/80 mmHg
  - No diabetes-related complications that interfere with safety of flight / mission completion
Summary

- **Type 1 Diabetes**
  - No waiver potential for USAF aircrew

- **Type 2 Diabetes**
  - Diet control – unrestricted waiver possible
  - Metformin – must fly with another qualified pilot
    - Under review to consider unrestricted waiver in the future
  - Sitagliptin – hypoglycemia unlikely
    - Will be reviewed for possible addition to approved med list in the future