

Diabetes Mellitus Type 1 in Five Military Aviators: Flying with Insulin

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Overview: Diagnosis of diabetes mellitus (DM) type 1 results in medical disqualification for all military aviation duties all over the world. The main concern is hypoglycemia, which can cause sudden incapacitation. Efforts to reduce the glucose levels and long-term complications increase the frequency of hypoglycemia. **Purpose:** This paper reviews five newly diagnosed cases of DM type 1 in Israeli Air Force aviators that presented over the last 15 yr. Four of the aviators were allowed to continue on active duty with limitations and one was disqualified. **Methods:** The records of all five diabetic aircrew were reviewed. Aircrews are tested every 3 mo for HbA1c levels. Every year they receive dilated fundoscopic eye examination. They have lipid levels drawn annually and are seen by both an endocrinologist and a flight surgeon for general medical examinations. **Results:** Four of the aviators continued on active duty for years. No symptomatic hypoglycemia or sudden incapacitation occurred. Three of the four airmen experienced undesirable HbA1c levels. **Conclusions:** Our experience indicates that safely flying with newly diagnosed DM type 1 is possible. The cost of the demanding lifestyle of military aircrew members and the fear of hypoglycemic episodes can result in periods of sub-optimal glucose control.

Keywords: aircrew, diabetes, hypoglycemia, HbA1c.

DIABETES MELLITUS (DM) Type 1 results from autoimmune destruction of beta cells in the Islets of Langerhans in the pancreas (type A) or from idiopathic etiology (type B) (2). Reduced insulin secretion and decreased glucose usage contribute to diagnostic hyperglycemia. The metabolic dysregulations and glycosylation of proteins throughout the body cause secondary pathological changes in multiple organ systems (3).

Improvement of glycemic control reduces diabetic microvascular complications (8). Prevention of future end-organ complications requires intensive management, but this results in a threefold rise in the occurrence of hypoglycemic events (1). The fear of hypoglycemia and its central nervous manifestations contribute to submaximal therapy and inadequate disease control.

Only Israel and Canada report waiving military aviators with DM type 1. The Canadian case is a sole helicopter pilot who was allowed to continue in active aviation service (5). The civil aviation authorities of some nations do permit some aviators with DM type 1 to exercise private pilot privileges after 5 yr of satisfactory control and no complications like hypoglycemia or end-organ damage (4,7). This paper describes the Israeli Air Force experience with five military aviators who

presented with new onset DM type 1 over the last 15 yr. Four of these aviators continued serving in active aviation duty.

METHODS

During the last 15 yr, five new cases of DM type 1 were diagnosed among Israeli military aviators. The diagnosis was based on high levels of glucose, low levels of C-peptide, and presence of anti-islet cell antibodies. We reviewed the medical files of all these diabetic aircrew, who visited the Israeli Aeromedical Center between 1989 and 2004. Each is checked annually by a flight surgeon. A detailed history is taken with specific emphasis on the potential complications of diabetes and a physical examination is performed. In the case of the four aviators who were extensively followed, HbA1c was checked every 3 mo. These airmen received annual examination of blood urea nitrogen (BUN), creatinine, and urinary microalbumin level. An ophthalmologist completes annual dilated fundoscopic eye examinations and opticians do vision examinations. An endocrinology specialist reviews each case every year. A cardiac stress test is preformed every 3 yr after the age of 40.

Flight safety data for each aviator, consisting of accidents or near accidents, was obtained from the Israeli Air Force Safety Center. We also reviewed the waiver considerations of several other Air Forces and a number of civil aviation authorities. The military aviation authorities in all of the services we checked (U.S. Air Force, U.S. Navy, U.S. Army, British Royal Air Force, German Air Force) do not grant waivers for DM type 1. In addition, we did a thorough literature search on DM type 1 and flight.

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RESULTS

During the last 15 yr, five new cases of DM type 1 were diagnosed among Israeli Air Force aviators. All of them were Caucasian men without any familial history of diabetes. All of the aviators were treated with intensive insulin therapy. Two aviators were initially treated with an insulin pump, but one was switched later to multiple daily insulin injection therapy. The other three airmen were treated with multiple daily insulin injection therapy. Self-monitoring was performed in all aviators half an hour before takeoff, every 2 h on long flights, and 30 min before landing. In-flight carbohydrate supplementation was mandatory if the glucose levels were under $100 \text{ mg} \cdot \text{dL}^{-1}$ ($5.55 \text{ mmol} \cdot \text{L}^{-1}$).

The median age at diagnosis was 29.4 yr (range 24–47 yr). Three were pilots who were disqualified, but two of them, an F-15 pilot and a helicopter pilot, got special (non-medical) permission to continue in active military aviation service. Two were navigators, with one being a high-performance weapon system operator and the other a cargo navigator. The weapon system operator was transferred to duties teaching basic navigation to students. The only aviator completely removed from aviation service was a cargo pilot who was subsequently lost to follow-up. No cases of sudden incapacitation or other events that would jeopardize flight safety were related to these aviators during the 15 man-years of follow-up.

All the aviators received aggressive treatment to reduce their blood glucose levels. No cases of clinical hypoglycemia involving symptoms were recorded, although a few incidences of laboratory hypoglycemia with blood glucose levels between 30 and $60 \text{ mg} \cdot \text{dL}^{-1}$ (1.66 and $3.33 \text{ mmol} \cdot \text{L}^{-1}$) were recorded without accompanying symptoms at least once during routine blood glucose examinations in three aviators. Mean HbA1c levels in four of the cases were 6.8% to 7.6%. In the fifth case, a level of 5.6% was recorded, but he was lost to follow-up after being medically disqualified.

While mean HbA1c levels were viewed as satisfactory, episodes of HbA1C above 8% were noted 30–42.8% of the time in three aviators. Serum creatinine, BUN levels, and urine microalbumin were normal in all aviators at all examinations. No diabetic eye complications were noted, but one aviator developed distal sensory neuropathy.

DISCUSSION

Diabetes mellitus type 1 requires close attention and treatment to reduce immediate and long-term complications (6). Military aviators are usually permanently disqualified after the diagnosis is confirmed. Most of civilian aviation authorities disqualify or restrict aviators who develop DM type 1. The Canadian civilian aviation authority grants waivers for commercial aviators with well-controlled disease and no evidence of hypoglycemia or end organ damage (4). In the United States, the Federal Aviation Authority permits pilots with DM type 1 to exercise private pilot licenses after 5 yr of satisfactory control and no evidence of hypoglycemia or end organ damage (7).

There are several reasons for medical disqualification or restriction: the most serious of these are sudden

incapacitation from the neurological consequences of hypoglycemia, hypoglycemia unawareness, and the hypoglycemic events induced by aggressive insulin therapy (9). Long-term complications, although reduced by intensive treatment with insulin, still cause considerable morbidity and mortality, and can endanger flight safety by causing sudden incapacitation. Military aviators are exposed to the same dangers of diabetes, and have additional difficulties imposed by long hours of operation, a hectic lifestyle, and stressful duties.

Our experience differs from the common management of aviators with DM type 1. Although one aviator was disqualified and another was transferred to a less stressful working environment, two pilots continued operational aviation service in their airframes and both navigators continued active aviation service. Despite some elevated HbA1c levels in three aviators, only one developed any permanent disability in the form of distal neuropathy. Furthermore, low laboratory glucose levels found incidentally in three aviators were not correlated to any behavioral manifestations of hypoglycemia. This fact can be explained by the high-intensity treatment regimens, good compliance to treatment, and the short time since diagnosis.

To the best of our knowledge, there is only one previous report on a military aviator with DM type 1 who continued in active aviation service (5). This is the first report on a group of military aviators, including a high-performance aviator, with DM type 1 who continued in active military aviation service. During our follow-up, no cases of sudden incapacitation were found and there was only one case of long-term complications in the form of mild lower extremity distal neuropathy noted. However, the rigors of military aviation service and fear of hypoglycemia have led to sub-optimal glycemic control. Further studies should be accomplished before any decision is made that could alter military medical policy regarding DM type 1.

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