Hazardous Oral Hypoglycemic Agent (OHA) Use Among Pilots: A Diabetic Royal Bahrain Airforce Fighter Pilot Developing Hypoglycemia During Flight

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ABSTRACT

Here we report the case of a fighter pilot experiencing hypoglycemia during a flight mission due to oral hypoglycemic agent (OHA) treatment. This ended with the pilot losing consciousness. Pilot incapacitation due to any medical illness may affect flight safety and cause serious aircraft accidents. Hypoglycemia is a side effect of OHAs, which are typically used to maintain normal blood sugar levels. Although the hypoglycemic effects of OHAs are well known and treatable, if immediate action is taken, disaster aircraft crashes involving high-speed aircraft can occur due to loss of the pilot's consciousness and aircraft control. Hypoglycemia is considered a relatively rare medical illness that can lead to pilot incapacitation (relative to more common medical illnesses, such as cardiovascular or neurological disorders). Dropping blood sugar to a level that may affect the pilot's consciousness can lead to loss of aircraft control. Therefore, the goal of an aeromedical certificate and close follow-up of diabetic pilots is to reduce the risk of (or identify early) possible complications from disease or disease treatments that may contribute to fatal aircraft accidents. Here we report the effect of OHA on fighter aviators and the aeromedical concerns that should be addressed in treating diabetic fighter pilots to reduce the risk of medical illness that may lead to flight accidents.

Keywords : Consciousness, Hypoglycemia, Metformin, Pilot, Flight accident

INTRODUCTION

Hypoglycemia is a common, potentially avoidable consequence of diabetic treatment and is a major barrier to initiating or intensifying antihyperglycemic therapy to achieve better glycemic control[1].
Hypoglycemia can cause injury because of a sudden loss of consciousness and death if not treated immediately. Hypoglycemia leads to a combination of neuroglycopenia and autonomic neural stimulation that is characterized by faintness, tremor, sweating, hunger, and coma[2]. Although hypoglycemia is more severe and frequent in those with type 1 diabetes, it is important and cannot be ignored in type 2 diabetes (DM).

Pilot incapacitation due to any medical conditions or physiological changes may lead to a serious potential threat to flight safety. Therefore, hypoglycemia is considered a medical cause of pilot incapacitation (relative to other medical conditions, such as heart attacks or gastrointestinal illnesses). The aim of regular follow-up and medical fitness certificates for diabetic pilots is to avoid the expected fatal aircraft accidents caused by systemic diabetic complications or hypoglycemia secondary to its management and medications.

The following case describes a fighter pilot who suddenly lost consciousness during a high-speed aircraft flight mission due to hypoglycemia secondary to using OHA.

CASE PRESENTATION

A 48-years old male pilot, a known case of type 2 DM, suddenly lost consciousness during a high-speed flight. During the mission and before he lost consciousness, he felt dizzy and that he was about to faint. He alerted the co-pilot that he was not feeling well. Immediately, the pilot blacked out and, ultimately, became unresponsive to the tower control and the co-pilot. Fortunately, the co-pilot was well qualified to control the aircraft and made an emergency landing. The pilot was drowsy when he landed and was given water and juice immediately after landing. Although he was conscious and alert, he felt dizzy when he presented at the aviation medical center. At that time, he was seen by the flight surgeon on duty, a detailed history was taken, and full physical examinations were performed. Upon arrival at the medical center, the general appearance of the pilot was conscious, alert, and oriented but feeling dizzy. All his vital signs were stable except for low random blood sugar that improved after oral sugar intake. Systemic physical examinations showed a healthy pilot, responding well, cooperative, not distressed, not pale or dehydrated, and without significant findings. An electrical cardiogram revealed no evidence of arrhythmias or ischemic heart disease changes.

The pilot's past medical history before the incident showed a record of being overweight in the last 3 years. He had been instructed to include diet control and exercise to reduce his weight but showed no significant weight reduction. As a result, his blood investigations showed impaired blood sugar and lipid levels.

Close follow-ups were performed by a flight surgeon, who encouraged him to better control his diet; periodic checkups for weight control were done, and repeated biochemical tests were given. In addition, he was referred to a cardiologist and endocrinologist for medical assessments. A full cardiac examination, including echo and Treadmill Stress Test, found nothing abnormal. Follow-ups showed slight weight loss but insufficient to improve his blood lipid and sugar levels, as

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shown in frequent blood investigations. Therefore, he was prescribed metformin and rosuvastatin control the impairment of his blood sugar and cholesterol, respectively, with regular and detailed follow-ups of his weight and HbA1c and lipid profile tests. No significant major operations had been recorded in the past.

In the pilot's past medication history, the only medications prescribed under the supervision of a flight surgeon were rosuvastatin (Crestor, 10 mg once daily) and metformin (Glucophage, 500 mg twice daily). After the incident occurred, the pilot informed the flight surgeon that he had taken a second opinion from another endocrinologist regarding his blood sugar impairment. The endocrinologist prescribed him another OHA (sulfonylurea) besides metformin for better blood sugar control. The flight surgeon's opinion regarding taking another OHA was not sought at that time. The pilot started taking that OHA, which caused him to experience hypoglycemia on that mission.

DISCUSSION

DM is a common chronic disease that widely affects people worldwide. For diabetic control, diet is the first choice, through improved lifestyle and changed dietary habits. In addition, physical activity gives better results in controlling blood sugar levels. In US army aviators, a diabetic incidence of 0.47 per 1000 aviator-years per year may occur; and 78% of aviators will be removed permanently from army flying duties because of poor dietary control or developing a diabetic complication, such as coronary artery disease[3]. The risks in diabetic pilots may be divided into those intrinsic to DM itself (for example, cardiovascular disease, visual problems, and nephropathy) and iatrogenic complications (including hypoglycemia) [4].

Hypoglycemia is one of the predicted complications with patients on insulin or non-insulin treatment, although it is more common in those who require insulin therapy. In both cases, patients may develop faintness, sweating, hunger, and tremor because of neuroglycopenia and autonomic neural stimulation[5]. In addition, symptoms of hypoglycemia include dizziness or lightheadedness, anxiety, tremulousness, confusion, difficulty speaking, and miscommunication, all of which affect the pilot's performance.

A workgroup of the American Diabetes Association (ADA) has classified hypoglycemia in diabetes as shown in Table 1[6].

Table 1: Classification of hypoglycemia

Severe hypoglycemia	Requiring assistance of another person to actively administer carbohydrates, glucagon or take another corrective action
Documented symptomatic hypoglycemia	- An event during which typical symptoms of hypoglycemia -Plasma glucose concentration ≤ 3.9 mmol/L
Asymptomatic (Documented) hypoglycemia	-An event not accompanied by typical symptoms -Plasma glucose concentration ≤ 3.9 mmol/L
Probable symptomatic hypoglycemia	An event during which symptoms typical of hypoglycemia are not accompanied by a plasma glucose determination but was presumably caused by plasma glucose concentration ≤ 3.9 mmol/L
Pseudo-hypoglycemia	-Typical symptoms of hypoglycemia -Plasma glucose concentration >3.9 mmol/L

OHA is used if dietary control and physical activity fail to control blood sugar levels. Many groups of OHA are used in the treatment of DM to maintain normal blood sugar levels, but most have a hypoglycemic effect with varying rates. Aeromedical concerns are raised from the direct effect of hypoglycemia on diabetic pilots that may occur from using OHA. Hypoglycemia may affect the pilot's cognitive function, resulting in incapacity while flying and possibly leading to a fatal accident. It was found that 43 pilots out of 1491 involved in fatal accidents had DM and that 12 of the 43 cases were taking anti-diabetic medication[7].

To some extent, hypoglycemia can aggravate critical illness-induced neuro-cognitive dysfunction[8]. It can also deteriorate attentional flexibility, information processing speed, and visual and auditory selective attention[9].

As showed in this case, the pilot experienced hypoglycemia because his blood sugar dropped to a level that ended in unconsciousness. For that reason, there are strict rules about the use of these agents by pilots who undertake high-altitude flight missions when their effects on the central nervous system are unacceptable. Therefore, the treatment of choice is very limited for diabetic fighter aviators. However, the alpha-glucosidase inhibitor acarbose does not have a systemic effect, and it regulates glucose absorption in the small intestine without hypoglycemic effect. Therefore, the drug of choice in treating diabetic fighter aviators is biguanide metformin because it is free of the effects of hypoglycemia[10]. Sulfonylurea has been recorded as a significant risk of developing hypoglycemia. A study of 50,048 types 2 diabetic patients showed the risk of hypoglycemia in patients using sulfonylurea is significantly higher than in patients using metformin[11]. A further study showed an increased risk of myocardial infarction and severe hypoglycemia in diabetic patients switched from metformin as a monotherapy to sulfonylurea[12].

This case is unique because it is the first of its kind reported in the Royal Bahraini Airforce. The diabetic fighter pilot was unable to return to flight duties since he did not meet the criteria of aviation medical waivers. Currently, there are two opposite stands in terms of civil aviation regulations for diabetic pilots: the American (Air Force Waiver Guide) regulations, which are stringent and prohibit the use of all anti-diabetes drugs except metformin; and the UK CAA regulations, that consider diabetic pilots fit for flying with any type of diabetic treatment, as long as they can demonstrate a good glycemic control and the multi-crew flight limitation is respected[13]. Though there are no official waivers that have been issued from Royal Bahraini Airforce, the United States Airforce (USAF) waivers are used as a guide to deciding his medical fitness for flying missions. The only medications officially approved for use in USFA aviators, ground-based operators, or other special duty operators are metformin and sitagliptin. These medications were approved after careful reviews demonstrated that – with appropriate restrictions – the risk of adverse effects of aeromedical consequence was acceptable, including the risk of both symptomatic and subclinical hypoglycemia[14]. The salient features are enumerated below.

- Using insulin is not compatible with a military flying career.
- Aircrews with impaired glucose tolerance but free of complications are fit for all flying duties.
- Regular follow-up to include fasting blood sugar every 6 months and HbA1c annually.
- Diabetic pilots, controlled by diet alone and without evidence of complication, are fit to fly or perform co-pilot duties.
- Biguanides (Metformin) as a treatment alone can be waived.
- Waivers may be terminated if BMI is above baseline, aircrews are non-compliant, there is a failure to perform regular checkups, HbA1c is greater than 7 mmol/dl on two occasions 3 months apart, or the pilot who required anti-diabetic drugs rather than biguanide.

CONCLUSION

The major aeromedical concern of diabetic pilots is hypoglycemia, which may affect performance and safety during flight. Therefore, fitness for flying depends on the treatment regimen and raising diabetic complications. Diabetic fighter pilots can fly by medical stipulations. The use by diabetic pilots of OHA is restricted in high-speed aircraft. Biguanide is the only permitted anti-diabetic medication for high-speed aircraft aviators that do not cause hypoglycemia. Further studies may require on the safety of using a different type of anti-diabetic drugs on the diabetic pilot before getting approved.

Appropriate education and awareness about aviation field hazards and how to protect pilots from chronic diseases, including DM, should be the first-line defense against medical episode-induced air accidents. Cooperation between aviation physicians and endocrinologists is required to reach the proper treatment regimen for the diabetic military pilot that is compatible with aviation safety rules. In addition, diabetic aviators need to be aware of the possibility of diabetic complications and side effects of anti-diabetic medications, which can affect pilot performance and safety, potentially resulting in fatal aircraft accidents.

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