

## Case Report

# Horizontal canal benign paroxysmal positional vertigo in a fighter pilot

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### ABSTRACT

Benign paroxysmal positional vertigo (BPPV) is the most common disorder of the peripheral vestibular system, characterized by intense, positional provoked vertigo. BPPV is thought to occur due to canalithiasis of the posterior semicircular canal. Recently, a new entity of BPPV, known as horizontal canal (HC)-BPPV, has been recognized. Although only 3 to 8% of BPPV is due to horizontal canal involvement, HC-BPPV is not rare. We present a case of a naval fighter pilot who had an incident of HC-BPPV on the ground. The pilot aeromedical evaluation and considerations are discussed.

**Key words:** Benign paroxysmal positional vertigo, case report, medical certification

### Introduction

Vertigo is the illusion of motion, usually rotational motion. If vertigo occurs in flight, it may lead to sudden incapacitation, thus impairing a pilot and possibly resulting in an accident.<sup>[1]</sup> Benign paroxysmal positional vertigo (BPPV) is the most common cause of peripheral vertigo.<sup>[2]</sup> It is considered to result from free-floating canaliths (canalithiasis theory) or from adherent particles in the cupula (cupulithiasis theory). BPPV presents vertigo of sudden onset that is provoked by certain changes in head position and is characterized by intense, positional provoked vertigo. Although the condition is termed "benign," the clinical presentation can be severe and incapacitating in certain situations. The posterior semicircular canal is the most commonly involved canal.<sup>[3,4]</sup> BPPV is thought to occur due to canalithiasis of the posterior semicircular canal and this hypothesis has been supported by many clinicians and researchers.<sup>[5,6]</sup> Recently, a new entity of BPPV, differing from that

mentioned above, has been recognized. This new entity is known as horizontal canal (HC)-BPPV. Although only 3 to 8% of BPPV is due to horizontal canal involvement,<sup>[7,8]</sup> HC-BPPV is not rare.

We present a case of a fighter pilot who had an incident of HC-BPPV on the ground. The pilot aeromedical evaluation and considerations are discussed.

### Case Report

A previously healthy 42-year-old male, Chinese naval command pilot with close to 2 000 flying hours, presented with positional vertigo accompanied with nausea and vomiting. No tinnitus was reported. The patient indicated that lying on his left side provoked his vertiginous symptoms, although he reported less intense symptoms when lying on his right side. The symptoms had started five days earlier as P vertigo episodes with mean duration ranging from a few seconds to two minutes, his symptoms were fairly mild or moderate in intensity. The vertigo attacks occurred in spells. The patient had several attacks a week. Clinical examination showed BP, 120/80 mmHg and heart rate, 76 beats/min. Otoscopy was normal. No spontaneous nystagmus in darkness and no pathological findings by standard clinical neurological examination were found. Vestibular evaluation was completed using binocular infrared videoculography.

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Dix-Hallpike maneuver did not evoke nystagmus or accentuation of his vertigo. Horizontal head impulse test, headshaking test, and vibration-induced nystagmus test and subjective visual horizontal<sup>[9]</sup> were normal. Hyperventilation testing was negative. No spontaneous nystagmus was found. Standard static positional testing revealed a persistent, geotropic nystagmus of 18 degrees per second in left lateral and 7 degrees per second in right lateral positions. The patient reported experiencing moderate, subjective vertigo with the left ear positioned downward and much less intense vertigo with the right ear downward. Calorics were normal. Vestibular Evoked Myogenic Potential (VEMP) showed normal amplitude responses on both sides. Audiogram was normal. Computed tomography scan and magnetic resonance imaging were normal.

Following vestibular evaluation, it was demonstrated that the patient did not have posterior or anterior canal BPPV (negative Dix-Hallpike to either side). Furthermore, the persistent geotropic nystagmus was consistent with a typical nystagmus that is observed with most cases of HC-BPPV, due to canalithiasis. A HC-BPPV diagnosis was definite. The patient was temporarily grounded and treatment with the use of HC-BPPV liberatory maneuvers, which was introduced by Appiani *et al.*<sup>[10,11]</sup> was recommended. For the Appiani maneuver, the patient is initially seated on the exam table. The patient is then moved into a lateral side-lying position with the unaffected ear down and kept in this position for two minutes. This duration allows the relatively heavy otolith debris to travel through the endolymphatic fluid in the canal. The head of the patient is then rotated 45 degree downward. After two minutes, the patient is returned to an upright position. The patient was admitted to therapy 2 weeks after the first attack. He responded favorably to treatment with the Appiani maneuver and continued habituation exercises during the following week. He was evaluated with side-lying test immediately and on days 3, 5, and 14 after the treatment. We repeated the maneuver until the patient is asymptomatic, and BPPV could not be provoked.

On follow-up at three months later, his symptoms had disappeared completely. Electroneurography showed no spontaneous nystagmus and still normal calorics. Hallpikes and side-lying maneuver did not evoke nystagmus. He was recommended for waiver for return to flying status in two-seat aircraft. This waiver recommendation was approved, and he was returned to flying status to fly with copilot six months after his episode of acute vertigo. A follow-up vestibular function evaluation 1 year later showed no change in his

condition, and he was continued on flying status with a follow-up period of 2 years.

## Discussion

### Horizontal canal benign paroxysmal positional vertigo

BPPV is the most common disorder of the peripheral vestibular system.<sup>[12]</sup> The age of onset is most commonly between the fifth and seventh decades. The incidence may range from 10 to 107 cases per 100 000 individuals per year. Two theories have been proposed to explain BPPV. Schuknecht suggested the term “cupolithiasis” in 1969,<sup>[13]</sup> which explains BPPV as resulting from adherent basophilic particles in the cupula making it unstable, hence causing the vertiginous feeling. The canalithiasis theory explains BPPV as resulting from free-floating debris (canaliths) in the posterior semicircular canal (SCC), causing abnormal endolymph circulation. Of the two theories, canalithiasis is most generally accepted as the cause of classic BPPV. Although BPPV can theoretically affect each of the three SCCs, the majority of all cases are of the posterior SCC.<sup>[14-16]</sup>

HC-BPPV is a recently proposed new entity of the positional vertigo syndrome.<sup>[17,18]</sup> A diagnosis of HC-BPPV is made based on the symptoms and finding of positional nystagmus. In HC-BPPV patients, turning one's head or body to either side in the supine position provokes vertigo, which usually lasts for several minutes. Based on these symptoms and on the presence of nystagmus, the origin of the disease in these patients is thought to be located in the horizontal canal. However, there is no definite evidence concerning the pathological localization of this new entity of disease.

HC-BPPV is generally self-limited and the rate of spontaneous remission is high, but in some patients, it may persist for several months.<sup>[12,15]</sup> Medications that were historically prescribed for symptomatic relief are largely ineffective; many, if not all, are disqualifying for use by pilots while flying. The primary management for BPPV includes maneuvers to reposition the debris into the utricle of the inner ear.<sup>[11,12,15,16]</sup>

HC-BPPV is easily treated using the methods of Appiani *et al.*<sup>[10]</sup> or Casani *et al.*<sup>[19]</sup> The Appiani maneuver is preferred for patients with geotropic nystagmus, while the Casani maneuver has been used for patients with apogeotropic nystagmus. The Appiani maneuver has been mentioned above. The Casani maneuver is quite similar to the Appiani with one key exception; the patient is moved from the initial seated position to a lateral side-lying position with the affected ear down.

The head is then rotated 45 degree downward. After two minutes, the patient is returned to an upright position. The Casani maneuver was developed to attempt to free any otoconial debris that may be adherent to the cupula of the horizontal semicircular canal.

### Aeromedical concerns

There is much concern regarding vertigo occurring while performing aviation duties.<sup>[20-23]</sup> A pilot's spatial orientation in flight is crucial, and any compromise of this orientation may easily result in a fatal accident. In addition to the unpleasant feeling associated with it, vertigo causes incapacitation and impairs any job requiring psychomotor skills.<sup>[12]</sup> Generally speaking, vertigo is considered as disqualifying for aviators unless it is treated successfully.<sup>[20,21]</sup> U.S. Air Force regulations state that "recurrent episodes of vertigo with or without nausea, vomiting, tinnitus, and hearing loss" are disqualifying.<sup>[24]</sup> However, an airman with a history of BPPV can be considered for return to flying duties after a period of observation, usually several months.<sup>[23]</sup> The U.S. Navy waiver guide states that "...vertigo...causes which are self-limiting and non-recurrent may well be waiverable once symptoms have abated."<sup>[22]</sup>

As mentioned above, for HC-BPPV, spontaneous remission is possible, and the treatment of HC-BPPV is usually very simple and effective. Since the condition is not associated with any sequelae, one might well consider a rapid return to flight after a successful treatment. However, the high recurrence rate in BPPV poses the question, "Is it safe to fly yet?" For the airman presented herein, the Appiani maneuver treatment is highly efficacious and the symptoms of this patient were completely resolved. Appiani *et al.* also reported successful treatment of 100% of their patients with HC-BPPV who presented with geotropic nystagmus.<sup>[11]</sup> Since the recurrence of this type of vertigo is unlikely, it is our opinion that the patient should be cleared to resume flying duties.

Considering that military pilots of high-performance aircraft may face the high-acceleration forces and vibration stimulation, it is anticipated that a vertigo attack of HC-BPPV would occur during military flight. In 1990, Martin-Saint-Laurent *et al.*<sup>[25]</sup> reviewed the causes of in-flight incapacitation in a commercial aviation setting. Between 1968 and 1988, of 1 800 aircrew flying on average 600 hours a year, 10 episodes of in-flight incapacitation occurred, one of which was from vertigo. In addition, the military aircrew's ability to complete an assigned mission could be seriously degraded by a recrudescence vertiginous episode from HC-BPPV, placing the aviator at risk. So, this concern has lead to the restriction of pilots

with HC-BPPV to fly in dual-controlled aircraft, although U.S. Navy waiver guide consider BPPV cases waiverable after symptoms have resolved.<sup>[22]</sup>

### Conclusion

The pilots with HC-BPPV could not be consider to return to flight unless they were treated successfully and their symptoms were fully resolved with the addition of no recrudescence under several months' observation. However, considering the complexities of military flight environment and out of concern for the safety of the aircrew, we suggested that waivers to return to limited flight duties (dual control pilot) are considered and granted in the pilots with HC-BPPV.

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