Pol J Aviat Med Bioeng Psychol 2022; 28(4): 25-30
DOI: 10.13174/pjambp.28.11.2025.03

CASE REPORT

SYNCOPE OF A PILOT DURING FLIGHT – A CASE STUDY AND ANALYSIS OF THE DIAGNOSTIC PROCEDURE

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Source of support: Own sources

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Abstract: Syncope is one of the most dangerous medical events that may occur in a pilot during flight. This article discusses a case of syncope in a pilot of a transport aircraft of the Polish Air Force, which occurred during flight. The diagnostic procedure included a wide range of cardiological and neurological examinations. Vasovagal syncope was identified as the cause of the loss of consciousness. The presented diagnostic recommendations and procedures are consistent with international aviation medicine standards, which require the exclusion of other causes of loss of consciousness and the assessment of the risk of recurrence before the pilot is cleared for flying duties. The article highlights the importance of proper diagnostics and health monitoring of aircrew members following syncope incidents in order to ensure the safety of flight operations.

Keywords: syncope, vasovagal syncope, loss of consciousness, military aircrew, aviation medicine

Cite this article: Rola M, Kurek MA: Syncope of a Pilot during Flight – A Case Study and Analysis of the Diagnostic Procedure. Pol J Aviat Med Bioeng Psychol 2022; 28(4): 25-30. DOI: 10.13174/pjambp.28.11.2025.03

INTRODUCTION

Syncope is one of the most dangerous medical events that may occur in a pilot during flight, leading to complete incapacity to operate the aircraft.

Syncope occurs relatively frequently in the general population. It accounts for 1–1.5% of all visits to hospital emergency departments, and in one-third of cases, the etiology remains unexplained. Syncope is generally not a symptom of serious medical conditions. Short-term mortality is 0.7% within 10 days and 1.6% within 30 days, while after one year it increases to 8.4%, with one-third of the deaths attributed to cardiovascular diseases. Approximately 25% of patients who experience syncope will suffer another episode within two years [12].

Due to its sudden and unpredictable nature, syncope presents a significant challenge in the medical assessment of aviation personnel. The most recent modification of diagnostic procedures and changes in restrictions concerning the performance of flight duties after episodes of syncope was based on an analysis of 40 cases of transient loss of consciousness among civilian pilots in 2021. A detailed diagnostic work-up, covering both cardiovascular and neurological conditions, is of key importance for further management and fitness-to-fly decisions in a pilot after a syncopal episode [1]. In a study by Sledge and co-authors on the causes of syncope among military pilots, it was shown that the etiology could be identified in only 72% of cases. The most common cause was vasovagal syncope, found in 24 out of 34 cases [17]. Syncope is also the most frequent type of in-flight medical emergency occurring in passengers [15].

Syncope is a complete loss of consciousness caused by cerebral hypoperfusion, with a rapid onset, short duration, and spontaneous full recovery. A sudden interruption in cerebral blood flow lasting 6–8 seconds may be sufficient to induce total loss of consciousness, as can a drop in systolic blood pressure below 60 mmHg [8].

Syncope may be preceded by prodromal symptoms, also referred to as the presyncope [3]. Syncope is classified by etiology into cardiogenic, reflex (neurally mediated), and orthostatic hypotension-related types [3]. A specific form of syncope in aviation is G-LOC (G-force induced loss of consciousness), which is defined as loss of consciousness caused by gravitational overload. According to data, as many as 10–20% of fighter aircraft pilots may experience G-LOC during their careers. In the case of G-LOC, appropriate preventive and training measures can be implemented to minimize the risk of future incidents [10].

Case Presentation and Diagnostic Procedure

A 30-year-old transport aircraft pilot was referred to the Department of Internal Disease at the Military Institute of Aviation Medicine (WIML) by the Military Aviation Medical Board (RWKL-L) following a brief loss of consciousness onboard an aircraft. During a multi-crew flight, while descending, he experienced pain and a sensation of blockage in his right ear. As a result, he performed the Valsalva manoeuvre several times, as recommended in such situations. Shortly thereafter, he developed nausea, a feeling of heat, dizziness, and then a several-second loss of consciousness. According to the aircrew present on board, the pilot did not exhibit convulsions, nor was there involuntary urination. Following the syncope, an immediate decision to land the aircraft was made. The pilot was transported to the nearest Emergency Room, where a head and chest computed tomography scan, an electrocardiogram, and laboratory tests were performed. These tests revealed no abnormalities. Pulmonary embolism was exculded based on a normal chest CT angiogram. Due to reported symptoms of infection, a PCR test for COVID-19 was performed, with a positive result. Given the mild course of the COVID-19 infection, the pilot was advised to undergo symptomatic treatment at home. After the isolation period, he was referred for a post-syncope examination to RWKL-L, and then to the Department of Internal Disease at WIML for further diagnostics of the loss of consciousness.

From the medical history, it should also be noted that the pilot had slept poorly the night before the flight due to his child's illness, and on the day of the flight, in addition to fatigue, he was experiencing a slight runny nose. He was undergoing chronic treatment for hypothyroidism with levothyroxine, denied any addictions, substance use, allergies, or the use of other medications. The family history for sudden cardiac death, significant cardiovascular, or neurological diseases was negative.

Upon admission to the Department of Internal Disease at WIML, the pilot's general condition was good, and physical examination revealed no abnormalities.

Laboratory tests showed mild leukopenia (3.71 thousand/µl), decreased monocyte count (4.9%, 0.18 thousand/µl), elevated LDL cholesterol fraction (124 mg/dl), and fasting glucose (103 mg/dl, with glycated hemoglobin at 5.4%). Other laboratory results, including CRP, NT-proBNP, TSH, potassium, sodium, and creatinine levels, were within normal limits.

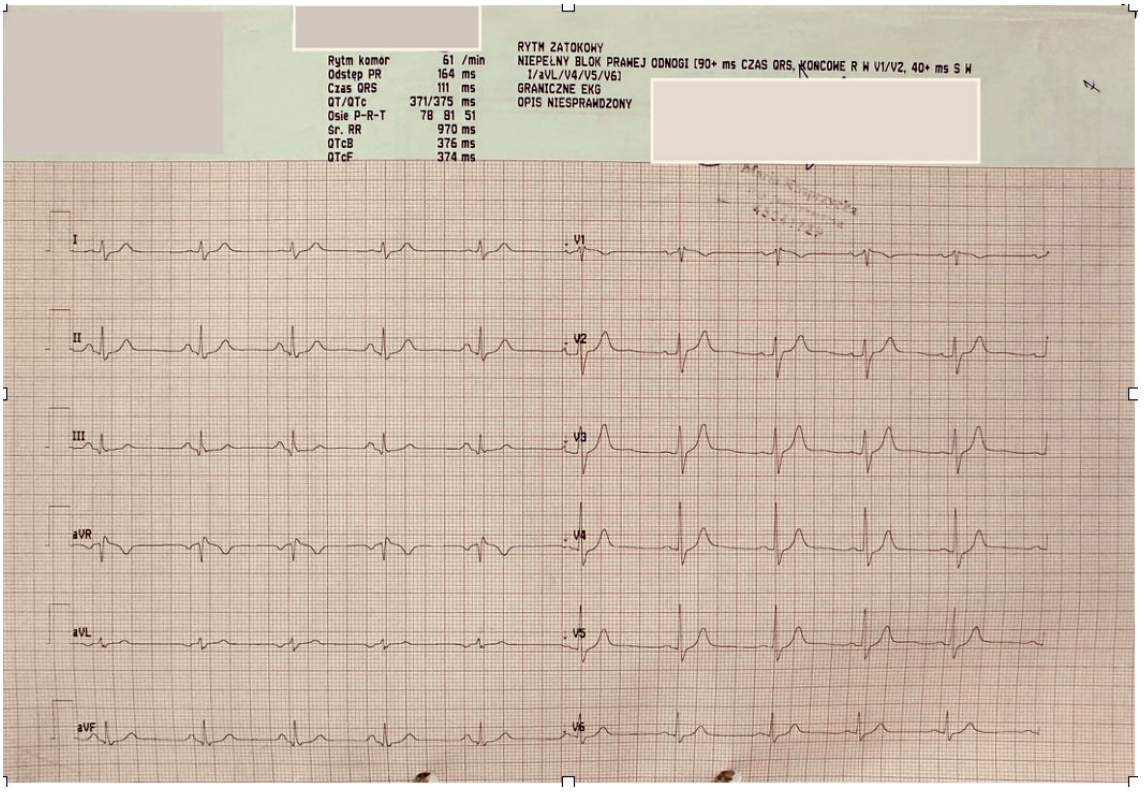

Fig. 1. A resting electrocardiogram recorded on admission to the hospital.

Resting electrocardiogram revealed a regular sinus rhythm at a rate of 61 bpm and an incomplete right bundle branch block (also present in previous ECG examinations from recent years).

In the 24-hour Holter ECG monitoring, sinus rhythm with an average heart rate of 66 bpm was recorded, along with occasional supraventricular premature beats. Echocardiographic examination revealed no abnormalities. Chest X-ray showed normal heart and lung images. The result of the exercise electrocardiographic test was negative, with very good exercise capacity (the test was discontinued at a workload of 15.1 METs). No decrease in blood pressure or heart rate was observed during the orthostatic test. The Valsalva manoeuvre was performed under ECG monitoring in a seated position. The pilot maintained an expiratory pressure of 40 mmHg for 15 seconds. Each attempt lasted at least 10 seconds and achieved a pressure exceeding 20 mmHg, meeting the diagnostic criteria of the test [14]. During the manoeuvre, no significant slowing of sinus rhythm or other rhythm or atrioventricular conduction disturbances were observed.

Due to the loss of consciousness, a neurological consultation was also conducted. Recommended tests (EEG, carotid artery ultrasound) showed no abnormalities. Based on the medical history and conducted tests, a neurological cause of the loss of consciousness was excluded.

After an otolaryngological consultation and confirmation of no contraindications for barofunction assessment, the pilot was referred for a Hypobaric Altitude Chamber (HAC) test. The result of the examination, using a standard protocol at an altitude of 5000 meters in the HAC, was normal, with good barofunction of the Eustachian tube.

Based on the history and test results, cardiovascular and neurological diseases responsible for the loss of consciousness were excluded. The most likely cause of the loss of consciousness in this pilot was reflex syncope associated with performing the Valsalva manoeuvre after a sleepless night and during an acute COVID-19 infection. The pilot was cleared for flight duties with a recommendation for follow-up evaluations by RWKL-L after 3 and 6 months. Due to the absence of recurrent syncope and no abnormalities in subsequent evaluations by RWKL-L, the pilot was cleared for unrestricted flying in Class I C.

CONCLUSIONS

Vasovagal syncope occurs relatively frequently in the general population. It is the most common cause of loss of consciousness in young individuals (between the ages of 10 and 30), with about half

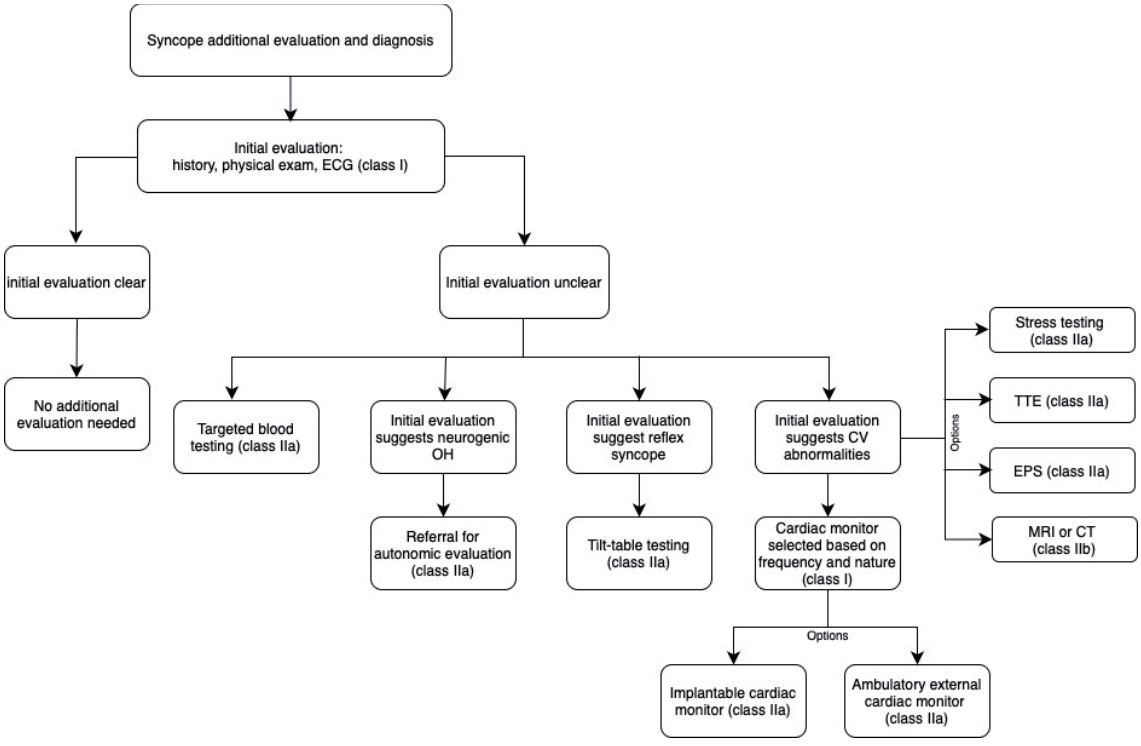

Fig. 2. Additional Evaluation and Diagnosis for Syncope [16].

Class I: Strong recommendation — the intervention is beneficial and effective, and is recommended for implementation.
Class IIa: Moderate recommendation — the intervention is reasonable, and the benefit outweighs the risk.
Class IIb: Weaker recommendation — the intervention may be considered, but the benefit is less certain.
CT – computed tomography; CV – cardiovascular; ECG – electrocardiogram; EPS – electrophysiological study; MRI – magnetic resonance imaging; OH – orthostatic hypotension; TTE – transthoracic echocardiography.

of these cases being recurrent [2,13]. According to Sutton's study, it is estimated that approximately half of all individuals will experience at least one episode of vasovagal syncope during their lifetime. It can potentially occur in anyone under appropriate provocative circumstances [18]. Due to the potential risk of serious consequences during flight, vasovagal reactions in pilots require confirmation through medical testing and exclusion of other conditions that could be responsible for the loss of consciousness [13].

Recommended procedures and diagnostic protocols in cases of syncope have been extensively addressed by various cardiology societies [3,16]. A clear and comprehensive algorithm for syncope management has been developed by American cardiology societies (Fig. 2.) [16].

The procedures outlined in the above recommendations pertain to the general population. In the context of aviation, every episode of syncope requires thorough cardiological and neurological evaluation. In the presented case, the syncope that occurred in the pilot during flight had clearly defined triggering factors, whose accumulation led to a short-term loss of consciousness. Fatigue due to a sleepless night, an acute COVID-19 infection, ear pain caused by atmospheric pressure changes, and the direct trigger — intense Valsalva manoeuvres — all contributed to a vasovagal reaction resulting in syncope.

A vasovagal reaction, resulting from excessive autonomic nervous system activity, can be triggered by various factors, including intensified Valsalva manoeuvres. This manoeuvre consists of attempting exhalation against a closed airway. After the manoeuvre begins, blood pressure initially increases, and heart rate also rises, but after several cardiac cycles, both heart rate and systolic blood pressure begin to drop—often falling below baseline values (Fig. 3). This occurs because the elevated intrathoracic pressure reduces venous return from the periphery, thereby decreasing cardiac filling and stroke volume [5,11]. These changes, in conjunction with other factors that impair the efficiency of the autonomic nervous system, may trigger syncope, as in the case of the pilot described in this article [4].

The use of the Valsalva manoeuvre in syncope diagnostics yields valuable insights into the body's autonomic responses to pressure changes. Proper interpretation of these changes is crucial,

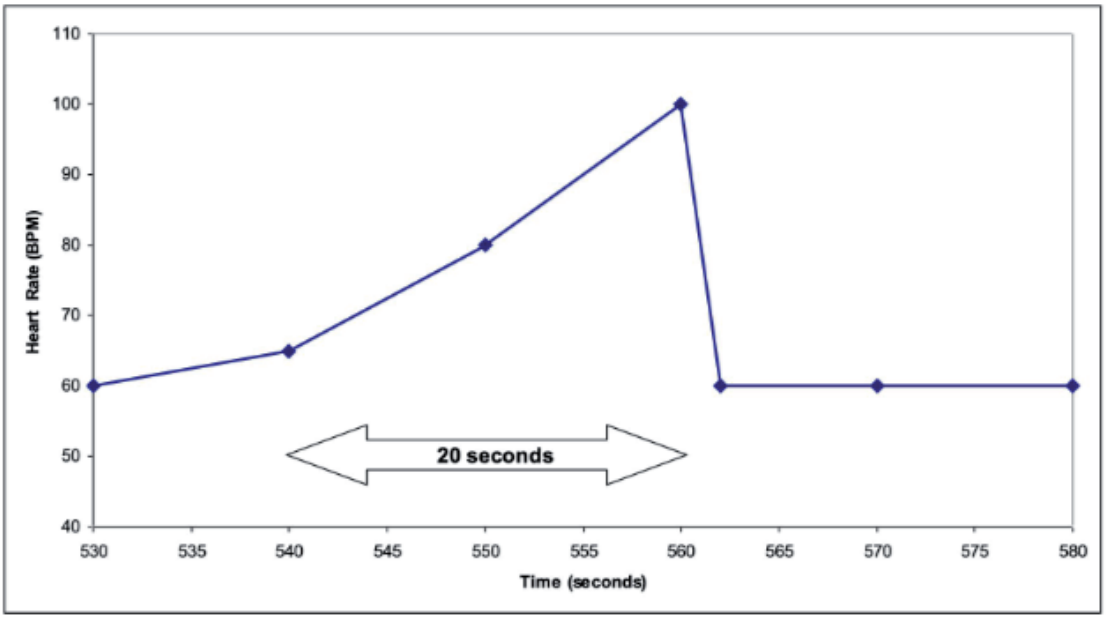

Fig. 3. Changes in Heart Rate During the Valsalva Manoeuvre [5]

particularly when assessing a pilot's fitness to continue in aviation service [4].

In the examined pilot, repeated Valsalva manoeuvres—both under standard conditions and under reduced pressure in a hypobaric chamber—allowed the risk of recurrent vasovagal syncope to be assessed as very low.

The tilt table test is a fundamental examination in the diagnosis of reflex syncope. However, due to the clearly identified link between the presented syncope episode and the intense Valsalva manoeuvre—as well as the fact that it was the pilot's first and only such incident—this test was not performed. Diagnostics focused on the Valsalva manoeuvre as a provocative test, which allowed for evaluation of the autonomic response in conditions similar to those that had triggered the syncope. In the case of further episodes or unclear circumstances of syncope, a tilt table test would be mandatory.

European aviation medicine regulations state that pilots who have experienced a single episode of reflex syncope may be considered fit to fly, provided there is no risk of recurrence. Additionally, flying personnel must undergo thorough cardiological and neurological evaluations to exclude other causes of syncope [19]. Similar regulations apply in the United States. According to Federal Aviation Administration (FAA) guidelines, a pilot may be cleared to fly after a single syncope episode only if the cause has been clearly identified. If the cause remains unknown, the pilot is disqualified from flight duties [7]. It should also be noted that G-LOC (G-force induced Loss Of Consciousness) is considered a physiological phenomenon that requires training [9,19]. Recurrent episodes of loss of consciousness, orthostatic or symptomatic hypotension, or recurrent vasodepressor syncope are grounds for disqualification from flight duties [6].

Procedures in Poland are consistent with the above principles observed in other countries. Flying personnel who experience loss of consciousness must undergo extended cardiological and neurological diagnostics, along with the establishment of a diagnosis. If test results are normal and the pilot is in good condition, they may be allowed to fly under temporary increased monitoring and observation. In the absence of recurrence and with a stable health condition, the pilot may be fully reinstated to flight duties without restrictions.

AUTHORS' DECLARATION

Study Design: Magdalena Rola, Michał A. Kurek. **Data Collection:** Magdalena Rola, Michał A. Kurek. **Manuscript Preparation:** Magdalena Rola, Michał A. Kurek. The Authors declare that there is no conflict of interest.

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