



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

Medical Factual Report **April 1, 2022**

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Medical Officer

A. ACCIDENT: CEN21FA320 – Muscatine, Iowa

Date/Time: July 14, 2021; 12:38 p.m. (CDT)
Aircraft: Piper PA-28-180, N2801T
Injuries: 2 Fatal
Flight Conducted under Part 91 personal flight.

B. GROUP IDENTIFICATION

No group was formed for the medical evaluation in this accident.

C. DETAILS OF INVESTIGATION

Purpose

This investigation was performed to evaluate the pilot for medical conditions, the use of medications/illicit drugs, and the presence of toxins.

Methods

The Federal Aviation Administration (FAA) medical case review and the pilot's autopsy and Forensic Sciences Laboratory toxicology¹ reports were reviewed. Other pertinent scientific and regulatory issues were reviewed.

FAA Medical Case Review

According to the FAA medical case review, at the time of the accident, the 68-year-old male pilot held a third class medical certificate with the limitation that he must wear corrective lenses. At the time of the most recent exam (5/18/20), the pilot was 72 inches tall and weighed 165 pounds. He reported having 188 civil flight hours. He reported taking no medications and no medical conditions. No significant medical concerns were identified.

¹ The FAA Forensic Sciences Laboratory has the capability to test for more than 1300 substances including toxins, common prescription and over-the-counter medications, and illicit drugs. <https://jag.cami.jccbi.gov/toxicology/>

Autopsy

According to the autopsy performed by the Muscatine County Medical Examiner's Office, Muscatine, Iowa, the cause of death in the pilot was multiple blunt force injuries and the manner of death was accident. The medical examiner reported that the pilot had significant cardiovascular disease. The pilot had an enlarged heart (450 grams), evidence of remote myocardial infarction with scarring of his left ventricle, evidence of four remote coronary artery bypass grafts, and severe atherosclerosis with greater than 95% stenosis of his right coronary artery and left main coronary artery.

Toxicology

Toxicological testing performed by the FAA's Forensic Sciences Laboratory identified the sedating antihistamine diphenhydramine in the pilot's liver and spleen tissue. The inactive metabolite of tetrahydrocannabinol (THC), carboxy-delta-9-tetrahydrocannabinol (THC-COOH), was detected in the pilot's cavity blood at 2.3 nanograms per milliliter (ng/mL) and liver tissue. Ethanol was detected in the pilot's spleen tissue at 0.093 grams per hectogram (gm/hg).² Identification of ethanol in vitreous fluid was inconclusive and no ethanol was detected in liver tissue. N-propanol was also detected in his spleen tissue, but not in his vitreous fluid or liver tissue. Tissue samples were reported to have exhibited putrefaction.

Toxicological testing performed for the medical examiner's office detected diphenhydramine in the pilot's pleural blood at 260 ng/mL, caffeine was also detected in his pleural blood. Their lab did not analyze for THC-COOH because of an interfering substance. Ethanol was not detected in pleural blood at a detection limit of 0.01 gm/dL.

Diphenhydramine is a sedating antihistamine (commonly marketed as Benadryl) and is available over the counter in many products used to treat colds, allergies, and insomnia. Diphenhydramine carries the warning that use of the medication may impair mental and physical ability to perform potentially hazardous tasks, including driving or operating heavy machinery. The therapeutic range is 25 to 100 ng/mL and it has a half-life of 3 to 14 hours.³ Diphenhydramine undergoes postmortem distribution and central levels may be two to three times higher than peripheral levels.⁴ FAA provides guidance on wait times before flying after using this medication; post-dose observation time is 60 hours and the medication is not for daily use.^{5,6}

The marijuana plant (*Cannabis sativa*) contains chemicals called cannabinoids; THC is the primary psychoactive cannabinoid compound. THC's mood-altering effects include euphoria and relaxation. In addition, marijuana causes alterations in motor behavior, perception, and cognition.

² Grams per hectogram in tissue samples are directly comparable to grams per deciliter in liquid samples.

³ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Diphenhydramine.

<https://jag.camii.jccbi.gov/toxicology/DrugDetail.asp?did=50>.

⁴ Han, E, E Kim, H Hong, S Jeong, J Kim, S In, H Chung, and S Lee. 2012. Evaluation of postmortem redistribution phenomena for commonly encountered drugs. *Forensic Sci Int.* 219(1-3):265-271.

⁵ FAA. 11/13/19. What over-the-counter (OTC) medications can I take and still be safe to fly? OK-20-0302 https://www.faa.gov/licenses_certificates/medical_certification/media/OTCMedicationsforPilots.pdf

⁶ FAA. 7/2/21. [AllergyAntihistamineImmunotherapyMedication.pdf \(faa.gov\)](#)

Significant performance impairments are usually observed for at least 1-2 hours following marijuana use, and residual effects have been reported up to 24 hours.⁷

THC is rapidly metabolized but the rate of metabolism is not linear and depends on the means of ingestion (smoking, oil, and edibles), potency of the product, frequency of use, and user characteristics. The primary metabolite, 11-hydroxy-delta-9-THC, is equally psychoactive, but is rapidly metabolized to the non-psychoactive metabolite *THC-COOH*. THC is fat soluble, so is stored in fatty tissues and can be released back into the blood long after consumption. So, while the psychoactive effects may last a few hours, THC can be detected in the blood for days or weeks. Very little THC is excreted in urine. Instead, *THC-COOH* can be found in urine days to weeks after the last use of the drug. Thus, both blood and urine test results do not necessarily reflect recent use and cannot always be used to prove that the user was under the influence of the drug at the time of testing.⁸

Ethanol is a social drug commonly consumed by drinking beer, wine, or liquor. It acts as a central nervous system depressant; it impairs judgment, psychomotor functioning, and vigilance. Ethanol is water soluble, and after absorption it quickly and uniformly distributes throughout the body's tissues and fluids. The distribution pattern parallels water content and blood supply of the tissue. Ethanol can be produced after death by microbial activity; sometimes in conjunction with other alcohols, such as propanol. Extensive trauma increases the spread of bacteria and raises the risk of ethanol production after death.⁹

D. SUMMARY OF MEDICAL FINDINGS

The 68-year-old male pilot held a third class medical certificate with the limitation that he must wear corrective lenses. At the time of the most recent exam (5/18/20), he reported no medical conditions or medications. According to the autopsy, the cause of the pilot's death was multiple blunt force injuries and the manner of death was accident. Autopsy findings for the pilot included an enlarged heart (450 grams), evidence of remote myocardial infarction with scarring of his left ventricle, evidence of four remote coronary artery bypass grafts, and severe atherosclerosis with greater than 95% stenosis of his right coronary artery and left main coronary artery.

Toxicology testing detected diphenhydramine in the pilot's pleural blood at 260 ng/mL and in his liver and spleen tissue. *THC-COOH* was detected in the pilot's cavity blood at 2.3 ng/mL and liver tissue. Ethanol was detected in the pilot's spleen tissue at 0.093 gm/hg, was inconclusive in vitreous fluid, and was not detected in his liver tissue and pleural blood. N-propanol also detected in his spleen tissue, but not in his vitreous fluid or liver tissue.

⁷ National Highway Traffic Safety Administration. April 2014. Drugs and Human Performance Fact Sheets. Cannabis/Marijuana. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/809725-drugshumanperformfs.pdf>

⁸ Compton, R. July 2017. Marijuana-Impaired Driving - A Report to Congress. (DOT HS 812 440). Washington, DC: National Highway Traffic Safety Administration. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/812440-marijuana-impaired-driving-report-to-congress.pdf>

⁹ Kugelberg, FC and AW Jones. 2007. Interpreting results of ethanol analysis in postmortem specimens: a review of the literature. *Forensic Science International* 165(1):10-29.