



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

Medical Factual Report

April 27, 2020

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A. ACCIDENT: CEN19FA259; Sumner, Iowa

On August 8, 2019, at 0721 central daylight time, an Air Tractor AT-502B, N6113C, impacted power lines, a power line support pole, a tree and terrain near Sumner, Iowa. The pilot was fatally injured. The airplane was destroyed by impact forces and a postimpact fire. The airplane was registered to Air Advantage Inc., Mt. Pleasant, Iowa, and operated under Title 14 *Code of Federal Regulations* Part 91 as a positioning flight. Visual meteorological conditions prevailed, and the flight was not operated on flight plan. The flight originated from the Mt. Pleasant Municipal Airport (MPZ), Mt. Pleasant, Iowa, about 0615 and was destined for the Oelwein Municipal Airport (OLZ), Oelwein, Iowa.

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 certification file and the pilot's FAA medical case review, autopsy, personal medical records, and FAA Forensic Sciences toxicology reports¹ were reviewed. Other pertinent scientific and regulatory issues were examined.

FAA Medical Certification File and FAA Medical Case Review

According to the FAA medical certification files and FAA medical case review, at the time of the accident, the 56-year-old male pilot held a second class medical certificate with the limitation that he must have available glasses for near vision. At his most recent exam (10/29/18), he reported 21,000 total flight hours. The pilot was 69 inches tall and weighed 184 pounds. He

¹ The FAA Forensic Sciences Laboratory can test for more than 1,300 substances including toxins, common prescription and over-the-counter medications as well as illicit drugs. See: <http://jag.cami.jccbi.gov/toxicology/>

reported taking no medications. The pilot reported having diabetes controlled by diet. No other concerns were reported by the pilot and no significant medical issues were identified.

The pilot's FAA medical certification examinations dated to 1979. Medical certification applications in 1982, 1985, and 1986 were denied for drug convictions and psychological reasons; in July 1987 he received FAA approval for a third class certificate. Annual medical certification examinations had been performed since 1998 when the pilot first reported diet controlled diabetes. On this and subsequent exams, hemoglobin A1C results were reported.² On his recent exam, hemoglobin A1C was 6.8%.

Autopsy

According to the Iowa Office of the State Medical Examiner, Ankeny, Iowa autopsy report, the cause of the pilot's death was blunt force injuries with thermal injuries and the manner of death was accident. A tube was identified in the abdomen and stents were identified in the left anterior descending and right coronary arteries. The medical examiner reported the pilot had an enlarged heart (600 grams), moderate to severe aortic atherosclerosis, 50% narrowing of major coronary arteries, and an area of heart muscle fibrosis consistent with a remote heart attack. The medical examiner reported microscopic evidence of ongoing ischemic changes around the area of the previous heart attack. Lungs showed evidence of pulmonary hypertension and kidneys showed chronic damage. Blood vessels in the brain showed changes from hypertension. There was also evidence of a several days-old subarachnoid hemorrhage;³ the finding was supported by a positive brain protein indicator for traumatic brain injury.

Personal Medical Records

Medical records were received from the pilot's current primary care doctor's office for the year preceding the accident; his previous primary care doctor had retired. The most recent office visit was on 5/6/19. The primary care doctor followed the pilot's care from multiple specialists. In review of his social history from visits with the retired doctor in 2016, it was reported that it had been recommended the pilot seek disability, "however when he does this it interferes with the government licenses for pilot airplane flying."

The pilot was followed for chronic kidney disease and received dialysis; he had a peritoneal dialysis catheter in place. On his first visit to the primary care doctor on 8/21/18, the pilot reported that he had been on the kidney transplant list but had been removed for multiple reasons including non-compliance. He was being treated for anemia. The pilot had diabetes treated with insulin and had complications of diabetic peripheral neuropathy, kidney damage, and diabetic skin lesions. His primary care doctor described the diabetes as "not well controlled."

² Hemoglobin A1C is a measure of the percentage of hemoglobin molecules that have a glucose molecule attached to them. The test measures the average blood glucose over the past three months. Above 6.5% indicates diabetes. For diabetic individuals, often the A1C goal is below 7.0%. [National Institutes of Health (NIH). U.S. National Library of Medicine (NLM). MedlinePlus. A1C. <https://medlineplus.gov/a1c.html> Page last updated 3/25/20]

³ A subarachnoid hemorrhage is bleeding in the space between the two innermost linings (arachnoid and pia mater) that cover the brain. A subarachnoid hemorrhage can be due to a head injury or from ruptured weakened blood vessels. [NIH. NLM. MedlinePlus. Subarachnoid hemorrhage. <https://medlineplus.gov/ency/article/000701.htm> Page last updated 4/9/20]

The pilot had a history of coronary artery disease. According to the primary care doctor records, the pilot had stents placed in 2010; after restenosis was found in 2013, additional stents were placed. At the 9/17/18 office visit, the pilot informed the doctor that was scheduled for a cardiac catheterization that week; there were no follow-up comments on the procedure. The pilot had a prescription for sublingual nitroglycerin to use as needed.⁴ The pilot had hypertension treated with carvedilol. He had a prescription for atorvastatin to treat high cholesterol.

The pilot was prescribed hydrocodone-acetaminophen (commonly marketed as Vicodin) and a fentanyl patch for his chronic pain due to cervical spinal stenosis. He had some gastrointestinal issues that the primary care doctor attributed to use of these medications. The pilot was prescribed medications for nausea. He also took pantoprazole (commonly marketed as Protonix) and ranitidine (commonly marketed as Zantac) for gastric reflux.

His past medical history included obstructive sleep apnea; no information was provided about treatment. The pilot was treated with tamsulosin for an inflamed and enlarged prostate. He had a prescription for daily use of trazodone for anxiety and for lorazepam as needed for anxiety. On the 2/11/19 visit, PCP stated she felt that the pilot had depression that was currently untreated; the pilot declined oral medication.

Toxicology

Toxicological testing performed by the FAA's Forensic Sciences Laboratory found hydrocodone at 190 nanograms per milliliter (ng/mL), dihydrocodeine at 41 ng/mL, fentanyl at 20.1 ng/mL, norfentanyl at 94 ng/mL, and trazodone at 901 ng/mL in the pilot's heart blood. Yohimbine and the non-sedating medications atorvastatin, carvedilol, pantoprazole, tamsulosin, and ranitidine were detected but not quantified in heart blood.^{5,6,7,8,9} With the exception of ranitidine, the other ten compounds were also detected in the pilot's liver tissue.

Toxicology testing performed for the Iowa Office of the State Medical Examiner detected hydrocodone at 55 ng/mL, dihydrocodeine at 17 ng/mL, fentanyl at 9.5 ng/mL, norfentanyl at 32 ng/mL, trazodone at 420 ng/mL, and yohimbine at 110 ng/mL in the pilot's femoral blood. The medical examiner's laboratory also reported lorazepam at 5.5 ng/mL and the fentanyl metabolite 4-ANPP in femoral blood. There were presumptive positives for opiates, benzodiazepines, and fentanyl/metabolites in the pilot's urine.

⁴ Nitroglycerin tablets are prescribed for the acute relief of an attack of chest pain due to coronary artery disease. [NIH. NLM. DailyMed. Nitroglycerin tablet. Updated 8/1/19.

<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=d6df0d74-9c72-0bfd-aab8-b4967ef46c54>]

⁵ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Atorvastatin.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=312>

⁶ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Carvedilol.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=247>

⁷ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Pantoprazole.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=236>

⁸ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Tamsulosin.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=285>

⁹ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Ranitidine.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=120>

Description of detected potentially impairing drugs

Hydrocodone is a semisynthetic opioid analgesic indicated for use in combination with acetaminophen to treat moderate to severe pain. As an opioid, hydrocodone carries a warning for its high risk of addiction, abuse, and misuse. Adverse reactions on the central nervous system from hydrocodone include drowsiness, mental clouding, anxiety, and impairment of mental and physical performance.¹⁰ *Dihydrocodeine* is a commonly found metabolite of hydrocodone, with an average concentration in blood about 29% of the hydrocodone value.¹¹ *Dihydrocodeine* has similar warnings and adverse reactions as hydrocodone.¹²

Fentanyl is a synthetic opioid analgesic; fentanyl patches are indicated for the management of severe pain in opioid-tolerant patients. As an opioid, fentanyl carries a warning for its high risk of addiction, abuse, and misuse. The most common adverse reactions in patients include nausea, vomiting, dizziness, sleepiness, fatigue, and insomnia.¹³ Fentanyl is predominantly metabolized to the inactive metabolite *norfentanyl*.¹⁴ *Despropionylfentanyl*, also known as *4-ANPP*, is a minor inactive metabolite of fentanyl.¹⁵

Trazodone is a tranquilizer used in the treatment of anxiety. It is also indicated for the treatment of major depression. It carries warnings about suicide risk and cardiac arrhythmias. Trazodone may cause sleepiness or sedation and may impair the mental and/or physical ability required for the performance of potentially hazardous tasks. Trazodone's therapeutic range is 500 to 2,500 ng/mL.^{16,17}

Yohimbine is an extract from the yohimbe bark. It is used as a dietary supplement to treat impotence, diabetic neuropathy, high blood pressure, and chest pain. It is also available by prescription to treat erectile dysfunction. Yohimbe has stimulant effects and can cause rapid heartbeat, anxiety, and high blood pressure; its use has been associated with heart attacks and

¹⁰ NIH. NLM. DailyMed. Hydrocodone bitartrate and acetaminophen. Updated 9/26/18.

<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=4f505b2a-45a2-4d34-96f6-dedb574cb508>

¹¹ Saitman, A, RL Fitzgerald, IM McIntyre. 2015. Evaluation and comparison of postmortem hydrocodone concentrations in peripheral blood, central blood and liver specimens: A minimal potential for redistribution. *Forensic Science International* 247:36-40.

¹² FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Dihydrocodeine.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=48>

¹³ NIH. NLM. DailyMed. Duragesic (fentanyl system)-Fentanyl patch. Updated 10/15/19.

<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=4c3a6171-19e4-40c2-83f3-fb54d4736e4b>

¹⁴ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Norfentanyl.

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=362>

¹⁵ Wilde, M, S Pichini, R Pacifici, A Tagliabracchi, FP Busardo, V Awarter, and R Solimini. 2019. Metabolic pathways and potencies of new fentanyl analogs. *Frontiers in Pharmacology* 10:1-16, Article 238.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6461066/pdf/fphar-10-00238.pdf>

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

<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=200>

¹⁷ NIH. NLM. DailyMed. Trazodone Hydrochloride. Updated 2/14/19.

<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=ed3039d8-3d27-4b71-a4b0-812943c9457f>

seizures. Yohimbine carries the warning that use may impair the mental and physical ability to perform hazardous tasks.^{18,19}

Lorazepam is a tranquilizer used in the treatment of anxiety disorders or for short term relief of anxiety symptoms. Lorazepam belongs to a class of drugs called benzodiazepines. The most common adverse reactions in patients include sedation, dizziness, and weakness. Lorazepam carries the warning that use may impair the mental and physical ability to perform hazardous tasks. Lorazepam's therapeutic range is 160 to 270 ng/mL.^{20,21}

D. SUMMARY OF MEDICAL FINDINGS

The 56-year-old male pilot held a second class medical certificate with the limitation that he must have available glasses for near vision. At his most recent exam (10/29/18), he reported taking no medications and having diabetes controlled by diet.

According to the autopsy, the cause of the pilot's death was blunt force injuries with thermal injuries and the manner of death was accident. Autopsy findings included chronic kidney disease with an abdominal dialysis tube, a several day-old subarachnoid hemorrhage, and extensive cardiovascular disease. For the latter, there was evidence of a remote heart attack, ongoing ischemic changes, an enlarged heart, moderate to severe atherosclerosis in his aorta and coronary arteries, and the presence of stents in his coronary arteries.

Personal medical records revealed that the pilot was being treated for chronic kidney disease with dialysis, diabetes with insulin, hypertension, high cholesterol, anxiety with trazodone and lorazepam, and chronic pain with hydrocodone and fentanyl patches. The pilot had coronary artery disease and had stents placed in 2010 and in 2013.

Toxicological testing found the sedating medications hydrocodone at 190 ng/mL, dihydrocodeine at 41 ng/mL, fentanyl at 20.1 ng/mL, trazodone at 901 ng/mL, and yohimbine (not quantified) in the pilot's heart blood. In femoral blood, hydrocodone, dihydrocodeine, fentanyl, and trazodone were detected at lower concentrations (55 ng/mL, 17 ng/mL, 9.5 ng/mL, and 420 ng/mL, respectively); yohimbine was detected at 110 ng/mL. Lorazepam was detected in femoral blood at 5.5 ng/mL. Several non-impairing medications used to treat the pilot's chronic medical conditions were also detected in heart blood.

¹⁸ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Yohimbine.
<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=351>

¹⁹ NIH. National Institute for Complementary and Integrative Health. Yohimbe. Updated 9/16.
<https://www.nccih.nih.gov/health/yohimbe>

²⁰ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Lorazepam.
<http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=83>

²¹ NIH. NLM. DailyMed. Lorazepam. Updated 12/3/18.
<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=a0fbf748-b127-420b-8ad9-5e3e36f82568>