

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA22FA262

MEDICAL

Specialist's Factual Report

April 11, 2023

A. ACCIDENT

Location: Greenville, Ohio
Date: 6/7/22
Time: 9:40 Local
Airplane: Enstrom 528; N600TA

B. MEDICAL SPECIALIST

Specialist Michelle Watters, MD, PhD, MPH
National Transportation Safety Board, RE-1
Washington, DC

C. DETAILS OF THE INVESTIGATION

Purpose

This investigation was performed to evaluate the pilot and pilot-rated passenger 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 and the pilot-rated passenger's autopsy and FAA Forensic Sciences Laboratory toxicology reports¹ were reviewed. The pilot's post-event medical record was reviewed. Other relevant medical and regulatory issues were reviewed.

D. FACTUAL INFORMATION

1.0 Pilot

1.1 FAA Medical Case Review

According to the FAA medical case review, at the time of the accident, the 34-year-old male pilot held a third class medical certificate without limitation. At his most recent and only FAA medical certification examination on 1/7/20, he reported 32 total flight hours and was 74 inches tall and weighed 320 pounds. He reported taking no medications or having any medical conditions.

¹ The FAA Forensic Sciences Laboratory has the capability to test for more than 1,000 substances including toxins, common prescription and over-the-counter medications, and illicit drugs. <https://jag.cami.jccbi.gov/toxicology/>

1.2 Autopsy

According to the autopsy report prepared by the Coroner's Office, Montgomery County, Dayton, Ohio, the cause of death of the pilot was multiple injuries, and the manner of death was accident. The pilot had evidence of medical intervention including vascular catheters; multiple intravenous bags, including fentanyl, accompanied the body. The pilot's heart was reported to weigh 615 grams. He was described as obese. No other significant natural disease was identified.

1.3 Toxicology

Toxicology testing performed by the coroner's office presumptively detected ketamine, its metabolite, and sevoflurane in the pilot's hospital blood. Toxicology testing performed by the FAA Forensic Sciences Laboratory detected ketamine in the pilot's heart blood at 41 nanograms per milliliter (ng/mL) and urine at 1,312 ng/mL; its metabolite norketamine was detected in his heart blood at 100 ng/mL and his urine at 1,302 ng/mL. Fentanyl was detected in the pilot's heart blood at 10.1 ng/mL and urine at 78.1 ng/mL; its metabolite norfentanyl was detected in the pilot's heart blood at 3.7 ng/mL and urine at 22.7 ng/mL. Midazolam was detected in his urine at 48 ng/mL, but not in his heart blood. The bronchodilator albuterol, the local anesthetic lidocaine, and the antibiotic trimethoprim were detected in his heart blood and urine; these three medications are generally considered non-impairing.²

The impairing medication ketamine is an anesthetic and used for pain management; its therapeutic range is 100 to 2,200 ng/mL and it has a half-life of 2 to 4 hours. Norketamine, a major metabolite of ketamine, is an active metabolite.³ Sevoflurane is an inhalational anesthetic used for general anesthesia.⁴ Fentanyl is a narcotic pain medicine which has a therapeutic range of 2 to 20 ng/mL and a half-life of 3 to 12 hours. Norfentanyl, the major metabolite of fentanyl, is an inactive metabolite.⁵ Midazolam is a short-acting sedative-amnestic medication commonly administered before surgery or medical procedures.⁶

² FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs.

Albuterol. <https://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=331>

Lidocaine. <https://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=148>

Trimethoprim. <https://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=203>

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

Ketamine. <https://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=82>

Norketamine. <http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=303>

⁴ National Institutes of Health (NIH). U.S. National Library of Medicine (NLM). [DailyMed - SEVOFLURANE liquid \(nih.gov\)](#). Updated 1/24/23.

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

Fentanyl. <http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=64>

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

⁶ NIH. NLM. [DailyMed - MIDAZOLAM HYDROCHLORIDE injection, solution \(nih.gov\)](#). Updated 12/14/21.

4.0 Post-Accident Medical Records

Post-accident hospital records were obtained for the pilot. The pilot had a subarachnoid hemorrhage with loss of consciousness, 30-39% third degree burns, acute blood loss, and other injuries. He had been given ketamine, was intubated, and received a blood transfusion prior to arriving at the trauma hospital. He received sevoflurane, fentanyl, midazolam, albuterol, lidocaine, and multiple units of blood and saline during his hospital stay. His serum drug screen was negative for ethanol and his urine drug screen was positive for benzodiazepines (he had been given the benzodiazepine midazolam prior to the urine collection). His pre-admission weight was given as 320 pounds. The pilot died two days after the crash.

2.0 Pilot-rated Passenger

2.1 FAA Medical Case Review

According to the FAA medical case review, at the time of the accident, the 35-year-old female pilot-rated passenger held a third class medical certificate without limitation. At her most recent and only FAA medical certification examination on 3/22/22, she reported 24 total flight hours and was 61 inches tall and weighed 198 pounds. She reported taking no medications or having any medical conditions.

2.2 Autopsy

According to the autopsy report prepared by the Coroner's Office, Montgomery County, Dayton, Ohio, the cause of death of the pilot-rated passenger was multiple blunt force and deceleration injuries to head, neck, and torso, and the manner of death was accident. No significant natural disease was identified.

2.3 Toxicology

Toxicology testing performed by the coroner's office detected diphenhydramine at 247 ng/mL in the pilot-rated passenger's femoral blood and 212 ng/mL in her heart blood. Toxicology testing performed by the FAA Forensic Sciences Laboratory detected diphenhydramine in her heart blood at 219 ng/mL.

Diphenhydramine is a sedating antihistamine (commonly marketed as Benadryl) that 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. The therapeutic range is 25 to 100 ng/mL and it has a half-life of 3 to 14 hours.⁷ Diphenhydramine undergoes postmortem redistribution and central levels may be

⁷ FAA. Updated 1/16/19. Forensic Toxicology's WebDrugs. Diphenhydramine. <https://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=50>.

two to three times higher than peripheral levels.⁸ 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.^{9,10}

E. SUMMARY OF MEDICAL FACTS

The 34-year-old male pilot held a third class medical certificate without limitation. At his most recent and only FAA medical certification examination on 1/7/20, he reported taking no medications or having any medical conditions. According to the autopsy report, the cause of death of the pilot was multiple injuries, and the manner of death was accident. There was evidence of medical intervention. The pilot's heart weighed 615 grams and he was described as obese. No other significant natural disease was identified.

Toxicology testing detected ketamine in the pilot's heart blood at 41 ng/mL, hospital blood, and urine at 1,312 ng/mL; norketamine in his heart blood at 100 ng/mL, hospital blood, and urine at 1,302 ng/mL; fentanyl in his heart blood at 10.1 ng/mL and urine at 78.1 ng/mL; norfentanyl in his heart blood at 3.7 ng/mL and urine at 22.7 ng/mL; and midazolam in his urine at 48 ng/mL. Sevoflurane was detected in the pilot's hospital blood. The generally non-impairing medications albuterol, lidocaine, and trimethoprim were detected in the pilot's heart blood and urine. Post-accident medical records show that all these medications were administered post-accident. The pilot had a subarachnoid hemorrhage with loss of consciousness, 30-39% third degree burns, and other injuries; he died two days after the crash.

The 35-year-old female pilot held a third class medical certificate without limitation. At her most recent and only FAA medical certification examination on 3/22/22, she reported taking no medications or having any medical conditions. According to the autopsy report, the cause of death of the pilot-rated passenger was multiple blunt force and deceleration injuries to head, neck, and torso, and the manner of death was accident. No significant natural disease was identified. Toxicology testing detected diphenhydramine at 247 ng/mL in the pilot-rated passenger's femoral blood and at 212 ng/mL and 219 ng/mL in her heart blood.

Submitted by:

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⁸ 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.

⁹ FAA. 11/13/19. What over-the-counter (OTC) medications can I take and still be safe to fly? OK-20-0302. [Over the Counter Medications \(faa.gov\)](https://www.faa.gov/over-the-counter-medications)

¹⁰ FAA. Updated 10/26/22. [AllergyAntihistamineImmunotherapyMedication.pdf \(faa.gov\)](https://www.faa.gov/allergy-antihistamine-immunotherapy-medication)