

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN23FA050

MEDICAL

Specialist's Factual Report

April 2, 2024

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A ACCIDENT

Location: Gage, Oklahoma
Date: November 28, 2022
Time: About 08:20 Central Standard Time

B MEDICAL SPECIALIST

Specialist JE Tuttle MD MHA FACS
National Transportation Safety Board
Washington, DC

C DETAILS OF THE INVESTIGATION

1.0 Purpose

This investigation was performed to evaluate the pilot/airplane owner (pilot) and the passenger for potentially impairing medical conditions and substances.

2.0 Methods

The final Federal Aviation Administration (FAA) medical case review and the pilot's FAA medical certification file, autopsy, and toxicology reports were reviewed. According to the National Transportation Safety Board investigator in charge, neither the pilot nor the passenger held a pilot certificate, and the passenger was witnessed in the front left seat during the accident flight. As such, it is not clear who was the operator at the time of the accident and thus, the passenger was included in this medical investigation, and his autopsy and toxicology reports were reviewed. Selected investigator reports and relevant regulation and medical literature were also reviewed.

D FACTUAL INFORMATION

1.0 Pilot

1.1 FAA Medical Records

According to FAA records, the 30-year-old male pilot's only aviation medical exam was on August 13, 2012. At that time, he was 73 inches tall and weighed 222 pounds. He reported a learning disability treated with methylphenidate (often marketed as Ritalin), a prescription medication that can be used to treat attention

deficit/hyperactivity disorder and narcolepsy. He also reported taking the prescription medication phentermine for weight loss. According to the FAA medical case review, both medications are unacceptable for pilots. The Aviation Medical Examiner deferred issuance of a third-class medical certificate and the FAA issued a general denial on July 8, 2013, for a history of attention deficit disorder (ADD) requiring medication.

According to the pilot's FAA medical certification file, in 2015, he requested reconsideration for an aviation medical certificate. The pilot underwent a formal neuropsychological evaluation on January 6, 2016, to facilitate the FAA's reconsideration. The evaluating clinical neuropsychologist concluded that the results of the evaluation revealed evidence of a risk of compromised pilot safety due to cognitive weaknesses and impairments on formal testing.¹ Based on the evaluation results, the FAA sustained the pilot's July 2013 denial for ADD on disqualifying medication, due to the pilot's disqualifying general medical condition (cognitive impairment as evidenced by abnormal neuropsychological testing).

1.2 Autopsy

The Board of Medicolegal Investigations, Office of the Chief Medical Examiner (OCME) of Oklahoma City, performed the autopsy of the pilot. According to the pilot's autopsy report, his cause of death was multiple blunt and sharp force injuries, and his manner of death was accident. His liver was noted to be enlarged and micronodular. The remainder of the autopsy examination of his brain, heart, and lungs did not identify other significant natural disease.

1.3 Toxicology

1.3.1 Autopsy Toxicology

Toxicology testing of postmortem blood and vitreous specimens from the pilot was performed by the OCME. Ethanol was detected in heart blood at 0.41 g/dL and vitreous fluid 0.42 g/dL. Phenobarbital was detected in heart blood and norchlorcyclizine was detected but not confirmed in heart blood.

¹ According to the neuropsychologist's summary, results of formal neuropsychological testing revealed evidence of cognitive impairment when compared to other pilots on certain aspects of divided auditory attention, executive function, language, processing with cognitive flexibility, and sustained attention (distractibility). Additionally, the pilot's performance was scored in comparison to less-strict non-pilot norms, and there was still evidence of cognitive impairment (5th percentile or lower) on sustained attention, processing speed with cognitive flexibility, visual-perceptual reasoning, and verbal abstract ability, with below average performances (less than 16th percentile) on divided auditory attention and hand fine-motor speed/dexterity.

1.3.2 FAA Toxicology

The FAA Forensic Sciences Laboratory performed toxicological testing of postmortem specimens from the pilot.² Ethanol was detected in cavity blood at 0.378 g/dL, in vitreous fluid at 0.431 g/dL, and in urine at 0.471 g/dL. Methanol was detected at a low level in urine but not in cavity blood or vitreous fluid. Phenobarbital was detected in cavity blood at 396 ng/mL and in urine at 338 ng/mL. 6-beta naltrexol was detected in heart blood and urine. Cetirizine was detected in femoral blood at 8 ng/mL and in urine at 76 ng/mL. Hydroxyzine was detected in femoral blood at 6 ng/mL and in urine at 7 ng/mL. Bupropion was detected in femoral blood at 6 ng/mL and in urine at 9 ng/mL. Hydroxybupropion was detected in femoral blood at 14 ng/mL and in urine at 53 ng/mL. Doxepin was detected in urine at 20 ng/mL and was also detected in femoral blood. Nordoxepin was detected in femoral blood at 13 ng/mL and in urine at 57 ng/mL.

1.3.3 Descriptions of Detected Substances

Ethanol is a type of alcohol. It is the intoxicating alcohol in beer, wine, and liquor, and, if consumed, can impair judgment, psychomotor performance, cognition, and vigilance. Effects of ethanol can significantly impair pilot performance.³ While the acute effects of ethanol can vary depending on an individual's frequency of use, body weight, and tolerance, in general, at blood ethanol concentrations as low as 0.02 g/dL, there is relaxation and some loss of judgment. Ethanol levels of 0.05 g/dL have been found to further degrade judgment, psychomotor functioning, and alertness. At blood ethanol concentrations above 0.10 g/dL, there is prolonged reaction time, altered perception of the environment, lack of coordination, slowed thinking, and mood and behavioral changes.⁴ FAA rules impose strict limits on flying after consuming ethanol, including prohibiting pilots from flying with a blood ethanol level of 0.04 g/dL or greater.⁵ Once ethanol is consumed, it is rapidly absorbed from the gastrointestinal tract and distributed into total body water. As ethanol is distributed in total body water, it uniformly distributes across tissues and into the brain.⁶ Vitreous fluid, and to a lesser extent urine, generally are better protected from microbial

² The FAA Forensic Sciences laboratory has the capability to test for around a thousand substances including toxins, prescription and over-the-counter medications, and illicit drugs.

³ Cook CCH. Alcohol and aviation. *Addiction*. 1997;92(5):539-555.

⁴ Centers for Disease Control and Prevention. Blood Alcohol Concentration (BAC). <https://www.cdc.gov/motorvehiclesafety/pdf/bac-a.pdf>. February 29, 2024.

⁵ Federal Aviation Administration. Alcohol and drug use in civil aviation. Federal Register :14 Code of Federal Regulations §91.17. <https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-91/subpart-A/section-91.17>. Accessed March 7, 2024.

⁶ Jones AW. Alcohol, its absorption, distribution, metabolism, and excretion in the body and pharmacokinetic calculations. *Wiley Interdisciplinary Reviews: Forensic Science*. 2019;1(5). doi:<https://doi.org/10.1002/wfs2.1340>.

spread, and thus generally are less susceptible to postmortem ethanol production, than are other specimen types.^{7,8}

Methanol, sometimes referred to as “wood alcohol,” occurs naturally at low levels in most alcoholic beverages. Low-level methanol in urine is not potentially impairing.⁹

Phenobarbital is a prescription long-acting barbiturate medication. It is a central nervous system (CNS) depressant and is commonly used for sedation and as an anti-seizure medication. Phenobarbital usually carries a warning that it has the potential for abuse and dependence (requiring increasing doses over time for the same effects).¹⁰ In addition, phenobarbital usually carries a warning that barbiturate use may impair mental and/or physical abilities required for the performance of potentially hazardous task such as driving a car or operating machinery. Phenobarbital also usually carries a warning that alcohol, narcotics, tranquilizers and antihistamines should not be used in combination with phenobarbital, as the concurrent use of other CNS depressants may result in additive CNS depression.¹⁰

The FAA states that phenobarbital, even if used for non-seizure indications, is a Do Not Issue/Do Not Fly medication.¹¹

6-beta-naltrexol is an active metabolite of naltrexone (which was not detected in this case). Naltrexone is an opioid antagonist indicated for the treatment of alcohol use disorders and to block the effects of opioids. It can be prescribed as part of a management plan for substance use disorders.¹² According to the FAA medical case

⁷ Federal Aviation Administration. Forensic Toxicology Drug Information. Ethanol. <http://jag.camijccbi.gov/toxicology/DrugDetail.asp?did=60>. Accessed February 29, 2024.

⁸ Savini F, Tartaglia A, Coccia L, et al. Ethanol Determination in Post-Mortem Samples: Correlation between Blood and Vitreous Humor Concentration. *Molecules*. 2020;25(12):2724. Published 2020 Jun 12. doi:10.3390/molecules25122724.

⁹ Botelho G, Anjos O, Estevinho LM, Caldeira I. Methanol in Grape Derived, Fruit and Honey Spirits: A Critical Review on Source, Quality Control, and Legal Limits. *Processes*. 2020;8(12):1609. doi:<https://doi.org/10.3390/pr8121609>.

¹⁰ National Institutes of Health National Library of Medicine. Phenobarbital oral solution. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=45f6317e-cfc9-4ec9-84c9-72daa6c68911>. Updated October 30, 2023. Accessed February 26, 2024.

¹¹ Federal Aviation Administration, Guide for Aviation Medical Examiners. Pharmaceuticals. Do Not Issue- Do Not Fly. https://www.faa.gov/ame_guide/media/DNI_DNF_tables.pdf. Updated June 28, 2023. Accessed March 27, 2024.

¹² National Institutes of Health National Library of Medicine. Naltrexone hydrochloride tablet. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=06ff2d5a-e62b-4fa4-bbdb-01938535bc65>. Updated September 6, 2022. Accessed February 29, 2024.

review, low-dose naltrexone is conditionally acceptable for pilots depending on the underlying condition being treated; however, if the underlying condition being treated is a substance abuse disorder, use is not acceptable.

Cetirizine is a second-generation antihistamine medication that is available over the counter and is commonly used to treat allergy symptoms. Cetirizine typically carries a warning that users may experience drowsiness and should use caution when driving a motor vehicle or operating machinery.¹³ Data on sedation and psychomotor impairment from cetirizine are mixed, with some studies but not others finding some sedating and impairing effects.^{14,15,16} The FAA states that pilots should wait 48 hours after using cetirizine before flying, to allow time for the drug to be cleared from circulation.¹⁷ Cetirizine can also be an active metabolite of hydroxyzine.

Hydroxyzine is a prescription medication that can be used to treat anxiety, as well as pruritis (itching) due to allergies. Hydroxyzine usually carries a warning that users may experience drowsiness and should use caution when driving a motor vehicle or operating machinery. Hydroxyzine will potentiate the effects of other CNS depressants, such as alcohol and barbiturates, and concurrent use of other sedating medications is not recommended.^{18, 19} The FAA states that anti-anxiety medications are Do Not Issue/Do Not Fly medications both for their sedating effects and the potentially underlying conditions being treated.^{Error! Bookmark not defined.,11} Norchlorcyclizine is a chemical that may be a metabolite of certain antihistamines including hydroxyzine.²⁰

¹³ National Institutes of Health National Library of Medicine. Zyrtec Allergy. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=b165db38-b302-4220-8627-77cb07bb078c>. Updated May 19, 2023. Accessed February 27, 2024.

¹⁴ Adelsberg BR. Sedation and performance issues in the treatment of allergic conditions. *Arch Intern Med*. 1997;157(5):494-500.

¹⁵ Moskowitz H, Wilkinson CJ. Antihistamines and Driving-Related Behavior: A Review of the Evidence for Impairment. National Highway Traffic Safety Administration. DOT HS 809 714. May 2004. <https://www.nhtsa.gov/sites/nhtsa.gov/files/antihistamines20text.pdf>. Accessed February 27, 2024.

¹⁶ Du Q, Zhou Y. Placebo-controlled assessment of somnolence effect of cetirizine: a meta-analysis. *Int Forum Allergy Rhinol*. 2016;6(8):871-879. doi:10.1002/alr.21746.

¹⁷ Federal Aviation Administration. Allergy - antihistamine & immunotherapy medication. Guide for Aviation Medical Examiners. https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/media/AllergyAntihistamineImmunotherapyMedication.pdf. Updated October 26, 2022. Accessed February 27, 2024,

¹⁸ National Institutes of Health National Library of Medicine. Hydroxyzine hydrochloride tablet. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=878b7e81-d904-457b-91bd-47129816cc60>. Updated January 19, 2007. Accessed February 29, 2024.

¹⁹ McIntyre IM, Mallett P, Trochta A, Morhaime J. Hydroxyzine distribution in postmortem cases and potential for redistribution. *Forensic Sci Int*. 2013;231(1-3):28-33. doi:10.1016/j.forsciint.2013.04.013

²⁰ Malcolm MJ, Cody TE. Hydroxyzine and Possible Metabolites. *Canadian Society of Forensic Science Journal*.

Bupropion is a medication prescribed as an antidepressant (commonly marketed as Wellbutrin) or for smoking cessation (commonly marketed as Zyban). Hydroxybupropion is the major active metabolite of bupropion.²¹ Bupropion use is contraindicated in users who consume alcohol. According to the FAA medical case review for this crash, bupropion was considered disqualifying for pilot medical certification. In May 2023, the FAA added extended-release and sustained-release (but not immediate-release) formulations of bupropion to the list of antidepressants that may be considered for FAA medical certification via special issuance.²²

Doxepin is a prescription tricyclic antidepressant medication (commonly marketed as Sinequan) used to treat psychoneurosis-associated depression and anxiety.²³ Doxepin is also used to treat depression anxiety associated with alcohol use disorders, and sleep disturbances associated with the depression and anxiety. Doxepin usually carries a warning that users may experience drowsiness and should use caution when driving a motor vehicle or operating machinery. Doxepin also carries a warning that use may increase risk of psychosis, mania, poor impulse control and should not be used in users who consume alcohol. Nordoxepin is a metabolite of doxepin.²³ According to the FAA medical case review, use of doxipen for any reason is not acceptable for pilots.

2.0 Passenger

2.1 FAA Medical Case Review

According to the FAA case review, the passenger was a 54-year-old male. He had no FAA medical certification file.

2.2 Autopsy

The Board of Medicolegal Investigations, OCME, Oklahoma City, performed the autopsy of the passenger. According to the passenger's autopsy report, his cause

1994;27(2):87-92. doi:<https://doi.org/10.1080/00085030.1994.10757029>.

²¹ National Institutes of Health National Library of Medicine. Bupropion hydrochloride tablet, extended release. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=39b2d509-1281-4464-9cf1-a94bbc18b84b>. Updated August 31, 2023. Accessed February 29, 2024.

²² Federal Aviation Administration. Guide for aviation medical examiners: decision considerations - aerospace medical dispositions, item 47, psychiatric conditions - use of antidepressant medications. Federal Aviation Administration website. https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/app_process/exam_tech/item47/amd/antidepressants. Updated June 28, 2023. Accessed March 27, 2024.

²³ National Institutes of Health National Library of Medicine. Doxepin hydrochloride. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=1513c98c-e7ef-4009-b932-6757048bb86a>. Updated May 16, 2023. Accessed March 14, 2024.

of death was multiple blunt force injuries, and his manner of death was accident. Due to the extent of the passenger's injuries, examination of the heart and lungs was limited. Within these limitations, the remainder of the autopsy examination did not identify significant natural disease.

2.3 Toxicology

2.3.1 Autopsy Toxicology

Toxicology testing was performed on blood, urine, and vitreous specimens, by the OCME. Ethanol was detected in cavity blood at 0.09 g/dL, in vitreous fluid at 0.14 g/dL, and in urine at 0.18 g/dL. Alprazolam was detected in cavity blood at 60 ng/mL and citalopram was detected in femoral blood at 0.76 µg/mL.

2.3.2 FAA Toxicology

The FAA Forensic Sciences Laboratory performed toxicological testing of postmortem specimens of the passenger.² Ethanol was detected in cavity blood at 0.109 g/dL. Ethanol was also detected in vitreous at 0.159 g/dL and urine at 0.199 g/dL. Alprazolam was detected in cavity blood at 51 ng/mL and in urine at 109 ng/mL. Alpha-hydroxyalprazolam was detected in urine at 58 ng/mL but was not detected in cavity blood. Citalopram was detected in cavity blood at 604 ng/mL and in urine at 3,334 ng/mL. N-desmethycitalopram was detected in cavity blood at 78 ng/mL and in urine at 684 ng/mL. Metoprolol was detected in cavity blood and urine.

2.3.3 Descriptions of Detected Substances

Ethanol is described above in section D.1.3.3.

Alprazolam (commonly marketed as Xanax) is a prescription benzodiazepine medication used to treat generalized anxiety disorders and panic disorders. Alprazolam generally carries a warning to use caution when operating machinery or driving a car due to CNS depression. The use of ethanol with alprazolam can produce additional CNS depressive effects including respiratory depression and respiratory failure leading to death. Alpha-hydroxyalprazolam is a less-potent metabolite of alprazolam.²⁴

Citalopram (commonly marketed as Celexa) is a prescription medication generally used to treat depression. Citalopram sometimes carries a warning that any psychoactive drug may impair judgment, thinking, or motor skills, and that users

²⁴National Institutes of Health National Library of Medicine. Alprazolam tablet. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=d2fd0b3e-9b78-44d0-82a6-96d6c6238750>. Updated March 2, 2023. Accessed March 14, 2024.

should be cautioned about operating hazardous machinery, including automobiles, until they are reasonably certain that the drug does not affect their ability to engage in such activities. N-desmethylocitalopram is a metabolite of citalopram.²⁵

Metoprolol is a prescription drug used to treat high blood pressure and certain conditions of the heart.²⁶ It is not generally considered impairing.

E SUMMARY OF MEDICAL FACTS

According to the FAA medical case review, the 30-year-old male pilot's only aviation medical exam was on August 13, 2012. At that time, he reported a learning disability treated with methylphenidate. He also reported taking phentermine for weight loss. The Aviation Medical Examiner deferred issuance of a third-class medical certificate and the FAA issued a general denial on July 8, 2013, for a history of ADD requiring medication. In 2015, the pilot requested reconsideration for medical certification. The pilot underwent formal neuropsychological testing on January 6, 2016. The evaluating clinical neuropsychologist concluded that the results of the evaluation revealed evidence of a risk of compromised pilot safety due to cognitive weaknesses and impairments on formal testing. Based on the evaluation results, the FAA sustained the pilot's July 2013 denial, due to the pilot's disqualifying general medical condition (cognitive impairment as evidenced by abnormal neuropsychological testing).

According to the pilot's autopsy report, his pilot's cause of death was multiple blunt and sharp force injuries, and his manner of death was accident. His liver was noted to be enlarged and micronodular.

The Office of the Chief Medical Examiner (OCME) of Oklahoma City performed toxicological testing of postmortem blood and vitreous specimens from the pilot. This testing detected ethanol in heart blood at 0.41 g/dL and in vitreous fluid 0.42 g/dL. Phenobarbital was detected in heart blood and norchlorcyclizine was detected but not confirmed in heart blood. The FAA Forensic Sciences Laboratory also performed toxicological testing of postmortem specimens from the pilot. This testing detected ethanol in cavity blood at 0.378 g/dL, in vitreous fluid at 0.431 g/dL, and in urine at 0.471 g/dL. Methanol was detected at a low level in urine but not in cavity blood or vitreous fluid. Phenobarbital was detected in cavity blood at 396 ng/mL and in urine at 338 ng/mL. 6-beta naltrexol was detected in heart blood and urine. Cetirizine was

²⁵ National Institutes of Health National Library of Medicine. Citalopram hydrobromide tablet, film coated. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=2632b547-2e13-447f-ac85-c774e437d6a8>. Updated September 2, 2023. Accessed March 14, 2024.

²⁶ National Institutes of Health National Library of Medicine. Metoprolol succinate capsule, extended release. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=90aa06a3-100f-4466-b950-506303707b01>. Updated February 7, 2018. Accessed March 14, 2024.

detected in femoral blood at 8 ng/mL and in urine at 76 ng/mL. Hydroxyzine was detected in femoral blood at 6 ng/mL and in urine at 7 ng/mL. Bupropion was detected in femoral blood at 6 ng/mL and in urine at 9 ng/mL. Hydroxybupropion was detected in femoral blood at 14 ng/mL and in urine at 53 ng/mL. Doxepin was detected in urine at 20 ng/mL and was also detected in femoral blood. Nordoxepin was detected in femoral blood at 13 ng/mL and in urine at 57 ng/mL.

1.0 Passenger

The 54-year-old male passenger had no FAA medical file.

According to the passenger's autopsy report, his cause of death was multiple blunt force injuries, and his manner of death was accident. No evidence of significant natural disease was identified.

The OCME of Oklahoma City performed toxicological testing of postmortem blood, urine, and vitreous specimens from the passenger. This testing detected ethanol in cavity blood at 0.09 g/dL, in vitreous fluid at 0.14 g/dL, and in urine at 0.18 g/dL. Alprazolam was detected in cavity blood at 60 ng/mL and citalopram was detected in femoral blood at 0.76 µg/mL. The FAA Forensic Sciences Laboratory also performed toxicological testing of postmortem specimens from the passenger. This testing detected ethanol in cavity blood at 0.109 g/dL. Ethanol was also detected in vitreous at 0.159 g/dL and urine at 0.199 g/dL. Alprazolam was detected in cavity blood at 51 ng/mL and urine at 109 ng/mL. Alpha-hydroxyalprazolam was detected in urine at 58 ng/mL but was not detected in cavity blood. Citalopram was detected in cavity blood at 604 ng/dL and urine at 3,334 ng/mL. N-desmethycitalopram was detected in cavity blood at 78 ng/dL and urine at 684 ng/mL. Metoprolol was detected in cavity blood and urine.

Submitted by:

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