NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

Medical Factual Report

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Chief Medical Officer

A. ACCIDENT: WPR16FA148AB; Zamora, CA

On July 23, 2016, about 0745 Pacific daylight time, an Air Tractor AT-502B, N502WC, and an Air Tractor AT-502B, N5044N, collided in-flight near Zamora, California. N502WC was operated by Farm Air as an aerial application flight under the provisions of 14 Code of Federal Regulations Part 137. The commercial pilot, the sole occupant, was fatally injured and the airplane was destroyed. N5044N was operated by Growers Air Service, and was operated as an aerial application flight under the provisions of 14 Code of Federal Regulations Part 137. The commercial pilot, the sole occupant, received minor injuries and the airplane sustained substantial damage. Visual meteorological conditions prevailed and company flight plans had been filed for both flights.

B. GROUP IDENTIFICATION

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

C. DETAILS OF INVESTIGATION

1. Purpose

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

2. Methods

   The FAA medical case review, autopsy report and toxicology test results for the deceased pilot, and the investigator's reports were reviewed. No toxicology testing was performed on the minimally injured pilot.

Deceased Pilot Flying N502WC

FAA Medical Case Review

According to the FAA files, 25 year old male pilot reported 2,250 total hours of civil flight experience as of his last medical exam, dated 3/30/2016. At that time, he was 68 inches tall and weighed 212 pounds. He had reported no chronic medical conditions and no use of medications to the FAA. No significant abnormalities were identified and he was issued a second class medical certificate without limitations.

Autopsy

According to the autopsy performed at the request of the County of Sacramento, Department of Coroner, the cause of death was multiple injuries and the manner of death was accident. No significant natural disease was identified but the examination was limited by the degree of damage to the body; the brain was absent.

At the time of autopsy, three loose white oblong tablets (2 of 3 tablets broken in half) with the imprint "M367" (consistent with acetaminophen and hydrocodone 325 mg/10 mg), were located in the pilot's pants pocket.

Toxicology

Toxicology testing performed at the request of the Coroner by NMS Laboratories identified hydrocodone at 46 ng/ml and its metabolite dihydrocodeine at 10 ng/ml in femoral blood; no other tested-for substances were identified.

Toxicology testing performed by the FAA's Bioaeronautical Sciences Research Laboratory confirmed two sedating antihistamines, chlorpheniramine and diphenhydramine, in subclavian and heart blood respectively. The levels for each were below the calibration curve of the instruments and below the lower end of the therapeutic ranges (see below for more detail on these two substances). Chlorpheniramine was also confirmed in liver and diphenhydramine was confirmed in muscle. In addition, 0.122 ug/ml of cyclobenzaprine and 0.085 ug/ml of its metabolite, norcyclobenzaprine, were found in heart blood. Both were also found in urine. Sertraline and its metabolite desmethylsertraline were found in liver and lung. Several opioid substances were also identified. Tramadol and its metabolite O-desmethyltramadol were found in urine but not in blood. Hydrocodone was detected in heart blood but could not be quantified due to some technical difficulties. Its active metabolite, dihydrocodeine, was quantified at 0.016 ug/ml in heart blood. Both of these and another metabolite, hydromorphone, were identified in urine. An opioid unrelated to the others, morphine, was also found in urine but not in blood.

Chlorpheniramine and diphenhydramine are sedating antihistamines available in a large array of over the counter cold and allergy products. Chlorpheniramine labeling contains the following warning, "When using this product, drowsiness may occur, avoid alcoholic beverages; alcohol, sedatives, and tranquilizers may increase drowsiness; use caution when driving a motor vehicle or operating machinery. Excitability may occur, especially in children." [1]

Diphenhydramine is also marketed as an over the counter a sleep aid. It carries a warning similar to chlorpheniramine.[2] However, compared to other antihistamines, diphenhydramine causes marked sedation; it is also classed as a CNS depressant and this is the rationale for its use as a sleep aid. Altered mood and impaired cognitive and psychomotor performance may also be observed. In fact, in a driving simulator study, a single dose of diphenhydramine impaired driving ability more than a blood alcohol concentration of 0.100%.[3]

Cyclobenzaprine is a prescription medication used to treat muscle spasm but has its main effects in the brain rather than directly on muscles. It is often marketed with the name Flexeril. Cyclobenzaprine is considered potentially impairing and carries this warning, "Cyclobenzaprine HCl may enhance the effects of alcohol, barbiturates, and other central nervous system depressants."[4] The therapeutic range, or the range of blood levels where effects would be expected in routine use (when used by itself), is between 0.0050 and 0.0400 ug/ml.[5] Cyclobenzaprine undergoes significant post mortem redistribution (drug moves back into blood from storage sites after death); as a result, levels in heart blood postmortem may be many times higher than antemortem levels.[6]

Sertraline is a prescription antidepressant often marketed with the name Zoloft. While not considered directly impairing, depression is associated with significant cognitive degradation, particularly in executive

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[1] National Institutes of Health. US National Library of Medicine. DailyMed. Chlorpheniramine tablets. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=8ffa168c-fe8a-4cd0-978d-c23678171e3f Accessed 1/29/2018.
[2] National Institutes of Health. US National Library of Medicine. DailyMed. Diphenhydramine. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=f3b177ef-55d5-4525-bf33-99205c414a5b Accessed 1/19/2018.
[3] Weiler JM, B.J., Woodworth GG, Grant AR, Layton TA, Brown TL, McKenzie DR, Baker TW, Watson GS., Effects of fexofenadine, diphenhydramine, and alcohol on driving performance. A randomized, placebo-controlled trial in the Iowa Driving Simulator. Ann Intern Med 2000. 132(5): p. 354-63.
[4] National Institutes of Health. US National Library of Medicine. DailyMed. Cyclobenzaprine Hydrochloride tablets. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=b12fb4ea-182e-462b-b6ed-cfd2f6bb71e8 Accessed 1/29/2018.
[5] Federal Aviation Administration. CAMI Forensic Drug Toxicology Information: Cyclobenzaprine. http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=133 Accessed 1/29/2018
[6] North Carolina Office of the Chief Medical Examiner. Toxicology. http://www.ocme.dhhs.nc.gov/toxicology/index.shtml Accessed 1/29/2018

functioning.[7] The cognitive degradation may not improve even with remission of the depressed episode, and patients with severe disease are more significantly affected than those with fewer symptoms or episodes.[8,9] This is the reason the FAA requires pilots being treated for depression to undergo additional evaluation beyond the usual medical certification.[10]

There was evidence of use of several opioids. Tramadol, an opioid available by prescription as a Schedule IV controlled substance is often marketed with the name Ultram, was found in urine but not in blood.[11] The Coroner's lab identified hydrocodone and its active metabolite dihydrocodeine in femoral blood. Hydrocodone is a Schedule II controlled substance available by prescription, most often in combination with acetaminophen; common names used in marketing are Norco, Vicodin, and Lorcet. This drug is considered to have high potential for abuse and users are warned, "Profound sedation, respiratory depression, coma, and death may result from the concomitant use of hydrocodone bitartrate and acetaminophen tablets with benzodiazepines or other CNS depressants (e.g., non-benzodiazepine sedatives/hypnotics, anxiolytics, tranquilizers, muscle relaxants, general anesthetics, antipsychotics, other opioids, alcohol)."[12] The therapeutic range for hydrocodone (when used alone in novice users) is considered between 0.0100 and 0.0500 ug/ml.[13] Because the specimen used by the Coroner was femoral blood, this level (46 ng/ml or 0.046 ug/ml) best represents the pilot's antemortem drug level. Dihydrocodeine is an active metabolite of hydrocodone. Its therapeutic range is considered between 0.0700 and 0.1500 ug/ml.[14]

Finally, morphine was found in the pilot's urine but not in blood. The presence of morphine in the urine may represent previous use of morphine, codeine, or heroin. Drugs found only in urine but not other

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[7] Snyder HR. Major depressive disorder is associated with broad impairments on neuropsychological measures of executive function: A meta-analysis and review. Psychol Bull. 2013;139(1):81-132.
[8] Nakano Y, Baba H, Maeshima H, Kitajima A, Sakai Y, Baba K, Suzuki T, Mimura M, Arai H. Executive dysfunction in medicated, remitted state of major depression. J Affect Disord. 2008;111(1):46-51.
[9] Paelecke-Habermann Y, Pohl J, Leplow B. Attention and executive functions in remitted major depression patients. J Affect Disord. 2005;89(1-3):125-35.
[10] Federal Aviation Administration, Guide for Aviation Medical Examiners, Item 47. Psychiatric Conditions - Use of Antidepressant Medications. https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/app_process/exam_tech/item47/amd/antidepressants/ Accessed 5/24/2016.
[11] National Institutes of Health. US National Library of Medicine. DailyMed. Tramadol. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=ae7c54b1-b440-4cca-97e8-e5b825413d32 Accessed 1/29/2018.
[12] National Institutes of Health. US National Library of Medicine. DailyMed. Hydrocodone and acetaminophen. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=fa32969f-7210-47ec-bbd1-f62bea8989a7 Accessed 1/29/2018.
[13] Federal Aviation Administration. CAMI Forensic Drug Toxicology Information: Hydrocodone. http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=73 Accessed 1/29/2018.
[14] Federal Aviation Administration. CAMI Forensic Drug Toxicology Information: Dihydrocodeine. http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=48 Accessed 1/29/2018.

body tissues are generally considered to no longer have any direct psychoactive effects.

Minimally Injured Pilot Flying N5044N

FAA Medical Case Review

According to the FAA files, the 64 year old male pilot who survived had reported 23,173 total civil flight hours as of his last medical exam, dated 10/15/2015. At that time, he was 67 inches tall and weighed 190 pounds. He reported the use of simvastatin, a cholesterol lowering medication, and visits to a dermatologist for care. He had previously reported orthopedic surgery. No significant abnormalities were identified and he was issued a second class medical certificate limited by a requirement that he wear corrective lenses.

Toxicology

No post accident toxicology testing was performed on the surviving pilot.

D. SUMMARY OF MEDICAL FINDINGS

The deceased 25 year old male pilot had reported no chronic medical conditions and no medication use to the FAA. According to the autopsy performed at the request of the County of Sacramento, Department of Coroner, the cause of death was multiple injuries and the manner of death was accident.

Post accident toxicology testing identified hydrocodone at 46 ng/ml and its metabolite dihydrocodeine at 10 ng/ml in femoral blood. In addition, two sedating antihistamines, chlorpheniramine and diphenhydramine, were found in subclavian and heart blood respectively. The levels for each were below the calibration curve of the instruments and below the lower end of the therapeutic ranges. Chlorpheniramine was also confirmed in liver and diphenhydramine was confirmed in muscle. In addition, 0.122 ug/ml of cyclobenzaprine and 0.085 ug/ml of its metabolite, norcyclobenzaprine, were found in heart blood. Both were also found in urine. Sertraline and its metabolite desmethylsertraline were found in liver and lung. Tramadol and its metabolite O-desmethyltramadol were found in urine but not in blood. Hydrocodone was detected in heart blood but could not be quantified due to some technical difficulties. Its active metabolite, dihydrocodeine, was quantified at 0.016 ug/ml in heart blood. Both of these and another metabolite, hydromorphone, were identified in urine. An opioid unrelated to the others, morphine, was also found in urine but not in blood.

The surviving 64 year old male pilot had reported the use of simvastatin to lower his cholesterol to the FAA. No postaccident toxicology testing was performed.