RECORD OF MEMORANDUM

Clinton O. Johnson
Senior Air Safety Investigator
Alaska Regional Office

Date: May 25, 2011
NTSB Accident Number: ANC10MA068
Subject: Neurological Evaluation

Narrative:
At the request of NTSB Human Performance staff, Maria Aguilar, M.D., a neurologist at the Mayo Clinic Arizona, reviewed medical evidence collected during the investigation of a DeHavilland DHC-3T accident that occurred on August 9, 2010, near Aleknagik, Alaska.
On December 9, 2010, Dr. Aguilar was provided medical evidence collected during the investigation, summary reports of interviews with the pilot's family and the Alaska Regional Flight Surgeon, and copies of the Operations Group and Meteorology factual reports. She was asked to provide a medical evaluation, assuming that witness and other evidence were credible, about the possibility of a neurologic event that could fit the accident scenario.
On January 20, 2011, NTSB Human Performance staff provided her with an email describing information learned during a witness interview conducted on January 19, 2011, that Human Performance staff stated corroborated impairment evidence provided previously to Dr. Aguilar in the form of another witness' interview summary. The email stated that the new witness observed the accident pilot staring into space and having trouble starting an airplane on July, 4, 2010. On January 24, 2010, Dr. Aguilar provided a draft copy of her report and, requested a copy of the interview summary for the new witness. The interview summary was transmitted to Dr. Aguilar on January 24, 2011, in an email from an NTSB Human Performance investigator who noted that it was from a credible witness who was describing a neurological condition similar to what the NTSB Human Performance investigator was hypothesizing for the accident. Dr. Aguilar's final report was received on February 24, 2011.

Additional witness interviews were conducted by members of the Operations Group between March 24-26, 2011. These interviews revealed information that contradicted some of the information upon which Dr. Aguilar's opinion was based. The information was not provided to Dr. Aguilar.

On May 19, 2011, the FAA submitted a copy of a letter written to Fred Tilton, M.D., the FAA's Federal Air Surgeon, from Joseph Sirven, M.D., a neurologist at the Mayo Clinic Arizona. The subject of the letter was a "Personal opinion regarding the NTSB Evaluation of a pilot who was involved in an aircraft accident." According to his letter, Dr. Sirven, had consulted with FAA about the investigation.

Both medical opinions are attached.

MAYO CLINIC

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[redacted]

February 24, 2011

Malcolm Brenner
National Transportation Safety Board
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Dear Mr. Brenner,

I have been asked by the National Transportation Safety Board (NTSB) to provide neurological opinion on case ANC10MA068, where a 62 year old right-handed pilot (Mr. Smith) was involved in an aircraft accident on August 9th 2010; the pilot in question and four other passengers died at the scene. There were a total of nine people aboard. The accident occurred about 10 miles northeast of Aleknagik, Alaska. The pilot had a history of cerebrovascular disease which is why a cerebrovascular neurology opinion is requested. I do not specialize in epilepsy.

The two questions I have been asked to address are:

1. Based on the pilot's history, are there any neurological events or conditions that could result in a severely reduced awareness of his environment ("loss of situational awareness") for a time period of at least 30 seconds, while the pilot remained conscious and still retained enough simple functioning to respond to avoid a last moment collision with trees that appeared ahead of him? We would appreciate if you would discuss the plausibility of any specific events or conditions.
2. Following his intracerebral hemorrhage, should the pilot have undergone additional evaluation or testing before being allowed to drive or fly?

I have had access to medical records from 2006 (year when the pilot suffered an intracerebral hemorrhage –ICH-), interviews conducted by NTSB after the accident, autopsy reports (three autopsies performed), accident reports, weather report, as well as verbal information provided by Dr. Mitchell A. Garber, M.D., NTSB Medical Officer and by Dr. Malcolm Brenner, PhD NTSB Human Performance Investigator.

1. The following neurological entities could account for short episode of unresponsiveness (under 1 minute)[1]: *syncope* (most common etiology is cardiac disease), *transient ischemic attack* (TIA) associated to right-left disorientation or visual-spatial disorientation, or *seizure* (either generalized or complex partial)[2]. Syncope is not per se a neurological condition, as the etiology varies and in most cases it is cardiac in nature. By definition, syncope is not followed by a post-ictal state, and impaired reaction or partial unawareness of the surrounding following a syncopal episode would not be typical[3].
Next in the differential is transient ischemic attack. A posterior circulation TIA (affecting the vertebral-basilar circulation), can cause transient decrease in blood flow to the reticular activating system[4, 5] (located in the

brain stem and supplied by the vertebro-basilar circulation) interrupting wakefulness and leading to transient unresponsiveness and or confusion. This clinical scenario is uncommon though[6, 7]. TIAs by definition last less than 24 hours, but most attacks resolve within 60 minutes[8]. A non-dominant hemisphere TIA causing visual-spatial disorientation could also account for impaired awareness and impaired ability to react for a short period of time[9].
The autopsy report was not consistent with focal ischemic (stroke), although early on (within hours) most infarcts are anemic or bland and difficult to discern on gross pathology[10].
A complex partial seizure (impaired awareness without generalized motor convulsive activity) followed by post-ictal state is another diagnostic possibility. There is no report by the surviving passengers about any unusual motor activity by the pilot to suggest a generalized convulsive seizure.

I am aware of Mr. Smith having episodes of abnormal behavior, documented on July 3rd, July 4th and the morning of the accident, when he was described as being distracted, "staring" and not following procedures appropriately (reports from Ernest C. Mitchell and Norman Lagasse). These could have been complex partial seizures and support the above statement about a seizure episode being the cause of the accident.
Prior history of stroke is a risk factor for seizure and/or epilepsy, in particular a prior intracerebral hemorrhage (ICH)[11, 12]. The risk of epilepsy after ICH is relatively low though, 13% between 30 days and 2 years post ICH, and 6.5% between years 2 and 5[13]. Seizure activity can be triggered by stress, sleep deprivation[14], alcohol consumption, among others.
The clinical scenario is not consistent with transient global amnesia (TGA)[15].

2. The pilot had suffered a right basal ganglia (caudate based on autopsy report, caudate and lentiform nuclei based on MRI report dated 7/21/2006) intracerebral hemorrhage, non-traumatic, in March 2006. He was 58 years old at the time. Mr. Smith's vascular risk factors included gender, dyslipidemia and family history of cerebrovascular disease. The notes mention also that he was prescribed Atenolol but hypertension was not documented.
Based on medical record review the hematoma measured 2.8 by 2.4 by 2.5 centimeters (~volume 16.7cm^3) involving the "right basal ganglia" with intraventricular extension (into the 3rd and 4th ventricles), mass effect with mid-line shift and "mild" hydrocephalus. CT angiography was normal. No surgical evacuation was required. The initial symptoms were identified by the pilot's wife at around 2AM; they had had intercourse at around midnight. The symptoms upon presentation were imbalance (bumped into wall), left sided weakness, and impaired speech ("talking gibberish"), emesis and an episode of urinary incontinence. His level of alertness was impaired (described as "sleepy but arousable") for several days. The impaired level of alertness in the setting of ICH is concerning for either subclinical seizure activity or post-ictal state. Seizures early on in ICH are a risk factor for the future development of epilepsy[16, 17].

Upon discharge from the hospital the pilot was reported as able to ambulate without assistance, on regular diet. Speech therapy (ST) recommended ST follow-up and neuro-psychometric testing. I find no report of formal neuro-psychometric evaluation or behind the wheel driving skills assessment.

In my opinion Mr. Smith should have undergone formal neuro-psychometric evaluation after the ICH and also diagnostic conventional angiography prior to being allowed to drive or fly again. An electroencephalogram (EEG) was also indicated during the hospitalization when his level of alertness was persistently impaired.
The etiology for Mr. Smith's ICH was not determined. Based on available information it was not due to a ruptured aneurysm, a vascular malformation, a tumor nor to cerebral amyloid angiopathy (no vascular abnormalities seen on autopsy and no micro-bleeds reported on GRE-MRI in 2006). Conventional cerebral angiography was indicated in an attempt to determine the etiology of the ICH[18]and to determine prognosis (risk of recurrence).

I am aware of the pilot's strong family history of intracerebral hemorrhage, but the autopsy excluded acute ICH/ICH recurrence or evidence of ICH outside the right basal ganglia (location of the ICH in 2006). The only potential way to link the pilot's family history with the ICH and the clinical entities outlined under #1 would be CADASIL (Cerebral Autosomal Dominant Arteriopathy with Sub-cortical Infarcts and Leukoencephalopathy)[19], but the radiologic studies from 2006 and the autopsy are not consistent with this clinical entity. There is no report of abnormal white matter.

In summary, I believe Mr. Smith experienced a seizure, secondary to the prior intracerebral hemorrhage, on the day of the accident. Initial work-up for the intracerebral hemorrhage should have included diagnostic conventional angiography, neuro-psychometric studies and electroencephalography.

Sincerely,

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Dr. Fred Tilton
Office of Aerospace Medicine, FAA
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RE: CLASSIFIED PATIENT

Personal opinion regarding the NTSB Evaluation of a pilot who was involved in an aircraft accident.

Dear Dr. Tilton:

I am writing this letter to convey my opinion in written format regarding the case that you and your colleagues at the FAA presented to me with regards to the ongoing investigation. I had received some medical records that were presented in a classified format for my personal review and there are no names or other descriptive items that would allow me to identify the particular individual involved.

In brief, the case presented to me was of a pilot who suffered a spontaneous intracranial hemorrhage at the age of 59 years, 4 and 1/2 months. He had subsequent improvement to the point that he was able to eventually return to work. His original evaluation had shown a significant intraparenchymal hemorrhage in the right basal ganglia, with extension into the lateral third and fourth ventricle, measuring 2.8 x 2.4 x 2.5 cm without hydrocephalus, minimal left forward midline shift, and mild mass effect on the left lateral ventricle. The patient ultimately recovered. A repeat MRI done almost a year after his intracranial hemorrhage showed an old parenchymal hemorrhage in the right basal ganglia, which continued to improve. About 2 years after this hemorrhage, he was issued an airman medical certificate.

The mishap in question happened about 4 and 1/2 years after the intracranial hemorrhage.

The pilot had been doing relatively well. There were reports in some of the documents presented to me in which the individual would stare off into space on occasion and there were other times where the pilot was somewhat distracted or quieter than usual. There were reports by some family members about the question of whether there was early Alzheimer's disease and sometimes the pilot just appeared to be distracted.

Two weeks prior to this mishap the pilot's son-in-law died in an airplane crash and there was a memorial service held for this pilot about 1 week prior to the mishap. The day of the mishap, there was a question as to whether the pilot

seemed to not be as engaged as he had been in the past. He did not have as much "energy" as had been noted at other occasions.

After review of the summarized records, my assumption based on this case is that there are many possibilities that could have accounted for this tragic mishap. In summary, the pilot may have had a seizure and this is supported by the elements of the staring episodes that was being reported by some witnesses. Alternatively, the patient had been under some stress given that his son-in-law, a pilot, had died only 2 weeks prior with the memorial service occurring the week before. Given that individuals who have intracranial hemorrhage are very prone to depression, it is very plausible that the pilot was distracted either by his mood or the recent circumstances surrounding a family member's death, which is a common and expected. This is especially true given the anatomic location of the intracranial hemorrhage

Based on these findings, there are a number of possible explanations that could account for the pilot's behavior and condition as presented in the supporting documents. No one single diagnosis can be necessarily proven by the description or the facts. Almost all of the potential explanations are plausible . Without the benefit of additional testing, the question as to exactly what happened medically could never truly be answered based on the facts as presented.

I am more than happy to answer any questions with regards to this case, to the best of my ability.

Joseph J. Siwen, MD

Professor and Chairman
Department of Neurology
Mayo Clinic Arizona
[redacted]