



Federal Air Surgeon's Medical Bulletin



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For FAA Aviation Medical Examiners, Office of Aerospace Medicine Personnel,
Flight Standards Inspectors, and Other Aviation Professionals.

U.S. Department of Transportation
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The Aging Brain, Cognition, and Aeromedical Concerns

Aeromedical Concerns Related to Age and Cognition

By Richard Ronan Murphy, MBChB

Si jeunesse savait; si vieillesse pouvoit (tr.) *If only youth had the knowledge; if old age had the ability*—Henri Estienne (1528-1598)

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THE YEAR 2010 ended with more than 650,000 U.S.-certified pilots, nearly 10% of whom were over the age of 65 and more than 4,700 over the age of 80. Nearly two-thirds of the pilots over age 65 held commercial, CFI, or ATP certificates, and nearly a quarter of those over age 80 were flight instructors (1).

Older pilots represent a significant proportion of certified pilots and bring a valuable wealth of knowledge and experience to the cockpit, and to the aviation industry.

Normal Aging and Flight Performance

Slight cognitive decline is not unusual with advancing age (2), though

knowledge and experience accumulate over time. Older age does not inevitably lead to cognitive decline, and significant cognitive decline should not be considered "normal aging."

The effect of aging on flight performance and safety has been the subject of considerable scientific study. It has been shown that certain tasks, such as radio communication and performance on approach, show decline with age in normal pilots (3), but it has also been shown that more advanced pilot proficiency ratings predict better piloting performance overall (4). There is a modest increase in accident rates

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Two Physicians Join OKC Certification Division Staff

By Courtney Scott, DO, MPH



NEW CERTIFICATION PHYSICIANS (L-R) Leigh Lewis, MD, and Judy Frazier, MD, pause for a moment from a briefing by Warren Silberman, DO, manager of the Aerospace Medical Certification Division.

THE AEROSPACE MEDICAL Certification Division is pleased to announce that two new physicians have signed on board, Dr. **Leigh Lewis** and Dr. **Judy Frazier**. They are the first women to serve as physicians in the Aerospace Medical Certification Division.

Dr. Lewis was born and raised in Orange Park, Fla. She learned to fly at an early age and obtained her pilot's license at age 17. She received her BS degree from Eckerd College in St. Petersburg, Fla., with a major in biochemistry and a minor in classics. In 2004,

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Aeromedical Research: Protecting the Safety of All Who Fly

HELLO, EVERYONE. In previous editorials, I have addressed pressing medical certification and aviation medical examiner training issues. I decided to “break” that tradition to brag about our two research divisions. AAM-500, the Aerospace Human Factors Research Division, and AAM-600, the Aerospace Medical Research Division, are located at the Civil Aerospace Medical Institute (CAMI) in Oklahoma City.

The mission of the Office of Aerospace Medicine is not limited to the certification and training of pilots, air traffic controllers, and aviation medical examiners. The scientists, engineers, and physicians in the research divisions conduct research on an enormous variety of subjects in order to improve the safety of the world’s airspace. Recently, aerospace medical research teams examined medical certification records and accident investigation reports of diabetic



pilots. Their findings revealed that a significant number of diabetic pilots do not report or are unaware of their condition. Researchers also found that 75% of insulin-dependent pilots were either overweight (44%) or frankly obese (31%).

In another study, our researchers determined that the prevalence of ischemic heart disease (IHD) in commercial transport pilots is lower than the prevalence of IHD in the U.S. general population. Researchers have also validated our atrial fibrillation special issuance policy by demonstrating that none of the mishaps involving a pilot with AFIB were associated with the pilot’s medical condition.

On a daily basis, aerospace medical researchers provide support to Federal Aviation Administration (FAA) and National Transportation Safety Board (NTSB) aircraft accident investigators by consolidating toxicology information, pilot medical certification history, and autopsy data. The information the researchers provide enables the accident investigators to determine if pilot medical issues, sudden incapacitation, or adverse pilot performance have contributed to an accident. Their findings also help us to assess our medical certification quality assurance program and to determine if our regulatory standards are sufficient.

The toxicology and biochemistry research programs are internationally recognized. They routinely receive autopsy samples from all different modes of transportation from around the world. Biomedical research engineers developed new criteria for the child- and infant-sized test dummies used to test restraint systems. They also conducted crash test evaluations on the new dummies to ensure their adequacy and to develop new design criteria that allowed industry and FAA certification

agencies to appropriately evaluate and certify the new restraint systems. Still other researchers are working on gene expression in medicine and tracking radiation hazards from lasers and cosmic sources.

Our Aerospace Human Factors Research Division conducts approximately 30 field and laboratory research projects every year in response to Aviation Safety and Air Traffic research requirements. For example, flight deck researchers teamed with industry representatives from the Air Transport Association to study airline maintenance and ramp operations during normal situations to develop Maintenance and Ramp Line Operations Safety Audit (LOSA) processes.

LOSA was first designed in the 1990s to assess cockpit operations as a formal process so that trained peer observers could collect safety-related data on performance in a non-jeopardy environment. LOSA gives an organization a diagnostic snapshot of safety strengths and weaknesses. It is a proactive approach that uses risk management principles to evaluate trends and incidents in order to interrupt a chain of events that might otherwise result in an accident. The team will shortly provide all these materials to the public for implementation.

Air Traffic researchers in the division are working to identify the aptitudes that will be required for individuals to enter the air traffic control specialist occupation as the world transitions to the new method of managing the national airspace system (NAS), known as *NextGen*. NextGen plans include monitoring air traffic by Automated Dependent Surveillance Broadcasts instead of radar; communicating primarily by datalink rather than voice; and using automation to manage the flow of traffic via computer-to-computer communication.

As you can see, NextGen will require fundamental changes in the way we manage traffic in the NAS, and this research will enable the air traffic organization to select individuals with the right skills to accommodate the changes.

Whether it be the latest application of gene expression in medicine; or utilizing state-of-the-art laboratory equipment to analyze tissue samples; or developing new protocols to evaluate the employee of the future; our world-renowned scientists play key roles in our mission to protect the safety of all who fly. I am very proud of them and their accomplishments, and I hope you are as well.

—Fred

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Electrocardiogram Problems

FOLKS, I HAVE sincerely attempted to avoid lecturing “down” to the aviation medical examiners because it seems to be unproductive; however, I have continued to notice a serious problem that only you can correct—not reviewing the electrocardiograms that are performed on first-class airmen. I had informed you three times¹ that I review all cardiovascular workups requested by our visiting cardiology consultant, Dr. **William Fors**.

I don’t know when it became the “norm” for you to ignore ECGs, but we need to get this under control. Among the many things that you as AMEs do, and I am mainly referring to our senior AMEs, but all other AMEs who perform examinations that require an electrocardiogram; for example, an initial hypertension evaluation. It is your responsibility as AMEs performing examinations to interpret the electrocardiograms you perform BEFORE you clear an airman for a medical certificate.

I am going to elaborate on some of the ECG abnormalities and what workups you can perform. This is one of the single most obvious areas that you can assist us with to reduce the backlog of cases that we must review. This will free us up to review other cases. In those previous *Bulletins*, I gave you a list of what the FAA considers as “normal variant” ECG changes (see sidebar chart). This means that if you have an interpreting ECG machine and you get one of these diagnoses or you read the graph and see one of these situations, you can clear the airman. We do not need a workup!

Oh, a quick footnote: There is nothing wrong with you having your electrocardiograms read by someone

¹ See Dr. Silberman’s columns in the 2008-1, 2008-3, and 2010-2 issues of the *Bulletin*; all of which are available online at www.faa.gov/library/reports/medical/fasmb/archives/

CERTIFICATION UPDATE

Information About Current Issues



By Warren S. Silberman, DO, MPH

who is more knowledgeable in their interpretation and then sending the findings in to us. I am going to spend the next *Bulletin* article describing the abnormal changes and what you can do to get your airmen cleared prior to granting them their medical certificate. I am pretty sure when an airman receives one of our letters requiring an evaluation for an abnormal ECG, they mention something to you or become upset.

Recently, I reviewed several hundred ECGs that our International AMEs sent in. Here are some of my observations and requests:

- Please get an ECG machine that has three simultaneous leads. Yes, come into the 21st century! We will still accept single-channel graphs, but when you need a new machine, please think of this.
- Do not have your technician cut out single complexes representing each lead and provide this. How else would we know if the airman has an arrhythmia?
- Interpret the electrocardiogram! Compare it with previous ones. If you see an abnormality and it is something that the airman has had in the past, then it won’t require an evaluation.

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Dr. Silberman manages the Civil Aerospace Medical Institute’s Aerospace Medical Certification Division.

ECG Normal Variant List

These are considered normal ECG variants and not reasons to defer the applicant

- Sinus bradycardia. Age 50 and younger — if the heart rate is 45 or greater; Age 50 and older — if the heart rate is 49 or greater
- Wandering atrial pacemaker
- Low atrial rhythm
- Ectopic atrial rhythm
- Indeterminate axis
- First-degree AV (atrioventricular) block with PR interval less than 0.21 in age 50 and younger
- Mobitz Type I Second Degree AV block (Wenckebach phenomenon)
- One premature ventricular contraction or atrial contraction on a 12-lead ECG
- Incomplete RBBB (Right Bundle Branch Block)
- Intraventricular conduction delay
- Early repolarization
- Left ventricular hypertrophy by voltage criteria only
- Low voltage in limb leads (may be a sign of obesity or hypothyroidism)
- Left axis deviation, less than or equal to -30 degrees
- rSR’ in leads VI or V2, ORS interval less than 0.12 msec R>S wave in VI without other evidence of right ventricular hypertrophy
- Sinus arrhythmia
- Sinus tachycardia: Any age — if the heart rate is less than 110
- Left atrial abnormality
- Short QT

Note: If a first-class airman does not have a current resting ECG on file but we have any type of stress test (pharmaceutical stress, Bruce stress, nuclear stress, or stress echocardiogram) that was accomplished within the last year, we can accept it without writing out for a current resting ECG; however, we do need the tracings from any of these tests. A cardiac cath and a Holter monitor test are not acceptable in place of a resting ECG.

ECGs from page 3

- Do not send us ECGs performed at 50 cycles per second. We are no longer going to accept them. We need them performed at 25 cycles per second.

The following is an introduction to the “Top Ten Things That an AME Can Do When Performing an Electrocardiogram for the FAA.”

1. If an airman has a heart rate less than 50, have the airman exercise in place and repeat the ECG. If the heart rate goes up above 50, send us both ECGs (in case this happens again down the road), and you can clear the airman.
2. This also goes for a significant first-degree AV block. Exercise the airman in place, and if the block becomes less, you may clear the airman.
3. If an airman has a rate over 110—sinus tachycardia—perhaps have the airman relax a bit and repeat the graph. If the rate drops below 110, send us the graph and clear the airman.
4. Two or more premature atrial contractions or ventricular contractions on an ECG requires the applicant to have a maximal nuclear stress test. If this has been previously worked up, you do not need to provide a new evaluation.
5. If the airman demonstrates new onset of complete right bundle branch block (in other words, this has not been seen on previous graphs), then you are to have the airman undergo a maximal nuclear stress test. NOTE: All stress testing in first- and second-class airmen should be maximal nuclear stress testing (unless we specify otherwise in our letter to you).
6. An airman who has an incomplete RBBB pattern on previous electrocardiograms, and then demonstrates a complete RBBB, does not require an evaluation.
7. An airman with a new onset of a complete left bundle branch block is to provide a cardiovascular evaluation and a pharmacologic nuclear stress test. This is one of the conditions

where we will accept a pharmacologic stress test. Airmen with a LBBB demonstrate what appears to be an area of ischemia in the septum, and the pharmacologic stress test helps better determine if there is actual ischemia.

8. An airman with left anterior or posterior hemiblock must demonstrate an absence of coronary artery disease, so a maximal nuclear stress test is required.
9. Limb lead III is the most variable lead. This lead sometimes is affected by respiration, which can falsely indicate that the airman had a previous inferior infarction. So if you have a small R-wave with a deep S-wave in that lead, and even perhaps in lead aVF, you need to perform an ECG in inspiration and again in expiration. If the S-wave disappears and you get a larger R-wave, you can clear the airman—but don't forget to provide us all these graphs.
10. An airman who has ST- and T-wave changes that suggest ischemia or left ventricular hypertrophy requires an evaluation if one has not been previously performed for this reason. No kidding, I have read ECGs here that, if I were in my office practice, the airman would have been sent immediately to the emergency room to be evaluated by a cardiologist! These situations require a cardiovascular evaluation, perhaps an echocardiogram, and definitely a maximal nuclear stress test.

Well, this concludes your *Introduction to Aeromedical Electrocardiography*. Please remember to read and interpret those ECGs before clearing the applicant because it will better serve your airmen and will also reduce our caseload here in Oklahoma City.

We appreciate all of you who work hard for us to improve the quality of our services. To reiterate something that the Federal Air Surgeon mentions at each seminar, “This whole program relies on you. We cannot do this without you!”



New CertDocs from page 1

Leigh graduated from the University of Miami School of Medicine. She then served on active duty in the U.S. Navy for four years.

During this time, she completed a surgical internship at National Naval Medical Center in Bethesda, Md., and served as a Flight Surgeon for VP-30 in Jacksonville, Fla. She then went on to the combined Aerospace and Internal Medicine Residency at the University of Texas Medical Branch in Galveston, Texas.

Dr. Lewis will primarily be working in the Medical Appeals Section here at the Civil Aerospace Medical Institute in Oklahoma City.

Dr. Judy Frazier graduated from the University of Oklahoma College of Medicine and is board certified in Family Medicine. She completed her residency in 2002, serving as Chief Resident in her final year.

She has since been an attending physician, urgent care physician, and was in private practice in Mustang, Okla., from 2004-2009. She earned her MBA in Health Care Management in 2005. She has worked at CAMI since 2009 in the Occupational Medicine clinic taking care of employees, students, and pilots. Her new duties will primarily be working general review cases.



Dr. Scott is the Deputy Manager of the Aerospace Medical Certification Division.

Older Pilots from page 1

amongst older pilots, and cognitive performance may play a role (5, 6). It is also important to keep in mind that visual, cardiovascular, respiratory and musculoskeletal problems frequently arise in old age, and may impact an older pilot's flight performance. Pilot experience is important. Higher pilot proficiency rating is associated with less performance decline with age (7).

Alzheimer's Disease and Other Dementias

One in eight people over the age of 65 have dementia. This risk increases with advancing age, for example: the risk is less than 1 in 20 at age 65 but affects nearly half of those over age 80 (8). Dementia is characterized clinically by cognitive and behavioral problems, severe enough to impair normal function. The pathological changes and some of the cognitive changes seen in dementia may precede the clinical expression of the disease by decades. The most common cause of dementia over age 65 is Alzheimer's disease and most often presents with memory difficulties.

Other diseases also commonly cause dementia. Vascular dementia is the probably the second most common type, followed by Lewy body dementia, a disease process which may show similar features to other dementias, but with some clinical features that differ from Alzheimer's, such as more Parkinsonism, visual hallucinations, more pronounced problems with attention and planning, and less memory disturbance. Bizarre behavior, personality change, poor executive function, poor judgment, and onset in mid-life suggest Frontotemporal dementia. In a very old population, only about a third of dementia autopsies demonstrated pure Alzheimer's pathology. Combined pathology in this group is more the rule than the exception (9).

Mild Cognitive Impairment

Mild cognitive impairment, or "MCI" is a term used to describe a clinical syndrome with a measurable reduction in cognitive performance, which does not reach the threshold of dementia, and does not interfere with the majority of normal daily activities (10). MCI may affect between 10-20% of individuals age 65 or older (8), and nearly 30% in those over age 85. It may be expected that pilots over 65 applying for an FAA medical exam would represent a select population with a lower prevalence of cognitive problems, but the prevalence in this group is unknown. MCI is not necessarily benign. Nearly half of MCI patients will progress within a few years to probable Alzheimer's disease (11).

Cognitive Deficits and Flight

Due to the nature of piloting requiring significant skill and cognitive performance, symptoms may present in the aviation domain before affecting other activities. It is not certain that a pilot will always be aware of problems with their flying. The American Academy of Neurology published driving guidelines in 2010 to address concerns about driving and dementia (12). This publication notes that persons with cognitive impairment frequently rated their driving as being much better than it actually was, while spouses' reports of functioning were much better correlated with actual driving function. A pilot's peers, instructor, or evaluator on a biennial flight review may be the first to notice problems. On the other hand, flight review tasks may be practiced extensively and may not identify an airman with mild cognitive decline. Common early difficulties may include problems with read-back or comprehension of ATC communications, difficulty learning how to operate equipment after changes, e.g., addition of new equipment, or software upgrade of a GPS device. Problems with frequently

missing points on checklists may indicate difficulty with attention and concentration. Any cognitive difficulties would be expected to be most evident and problematic in the setting of an in flight emergency or unplanned event.

Cognitive Screening – Role of the AME

The AME often has more frequent contact with the older pilot than any other aviation professional. The AME can provide a valuable service to the airman by identifying cognitive problems that may affect flight safety or that may need further evaluation and treatment.

A physician's evaluation of cognition usually begins with the history, but occasionally, unusual behavior and disheveled appearance may indicate a difficulty. More commonly, cognitive problems have an insidious onset and may not be apparent at all in superficial conversation. Asking about flight performance as part of the history may allow a pilot the opportunity to voice and discuss a concern that they may not have mentioned otherwise. Perhaps other pilots, instructors, or passengers have reported concerns to the pilot.

A question that I frequently encounter is, what to do if the pilot has problems with the electronic 8500-8 form, or Med Xpress. In my experience, it is not unusual for patients in their 70s or older to have difficulty completing this. These patients usually perform normally with pen and paper. The examining physician's overall clinical impression, based on a thorough history and exam, is most important.

In addition, the Alzheimer's Association has published a checklist of symptoms that may warn of onset of Alzheimer's:

Memory Changes That Disrupt Daily Life

- Challenges in planning or solving problems

Continued on page 6

Older Pilots from page 5

- Difficulty completing familiar tasks
- Confusion with time or place
- Trouble understanding visual images and spatial relationships
- New problems with words in writing or speaking
- Misplacing things and losing the ability to retrace steps
- Decreased or poor judgment
- Withdrawal from work or social activities
- Changes in mood or personality

While the presence of one or two of these symptoms does not make a diagnosis, presence of any of these symptoms warrants further evaluation.

A full cognitive and behavioral evaluation is beyond the scope of most AME exams, but the AME may wish to take advantage of simple tools that can help screen for suspected cognitive problems. The Mini Mental State Examination (MMSE) is a well-known tool used to screen for dementia, but a more sensitive screen may be undertaken in the office with a 10-minute pen and paper examination called Montreal Cognitive Assessment test, or MoCA. The test is very helpful when referring to a specialist for further evaluation and is available for download at no charge at www.mocatest.org.

If clinical suspicion of cognitive or behavioral problems arise, it is essential that this be confirmed with an informant, such as a spouse, colleague, close friend, or someone who has detailed knowledge of the patient's day-to-day functioning. The AME may be in the best position to do this and should do so with the pilot's permission.

It is important to be aware that not all cognitive problems are due to degenerative disease. Problems to consider include medical and metabolic factors such as hypothyroidism or Vitamin B12 deficiency, infection, sleep deprivation,

sleep apnea, alcohol or drug problems, medications, anxiety, depression, and psychosocial stress. Simple blood tests and a thorough history and physical exam will cover most of this.

Specialist evaluation must be obtained when there is not a clear explanation, when there is a rapid or stuttering onset, or when there is any concern for safety.

Summary

Older pilots have a wealth of experience that is of value to the aviation industry. The AME should consider the prevalence of cognitive disease with age, symptoms that may indicate cognitive problems and their potential impact on safety of flight. Not all cognitive problems are due to neurodegenerative disease. Early detection of cognitive problems not only improves pilot safety, but also provides an opportunity to screen for treatable causes of cognitive problems.

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- Note: All Web links referenced here were accessed on 8/12/2011.

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Aviation Medical Examiner Seminar Schedule

2011 SEMINAR		
November 18–20	Portland, Oregon	NEU (2)
2012 SEMINARS		
February 3–5	Charlotte, North Carolina	OOE (2)
March 5–9	Oklahoma City, Oklahoma	Basic (1)
March 30–April 1	Albuquerque, New Mexico	CAR (2)
May 14–17	Atlanta, Georgia	AsMA (3)
June 18–22	Oklahoma City, Oklahoma	Basic (1)
August 10–12	Washington, D.C.	NEU (2)
October 4–6	La Jolla, California	CAMA (4)
October 29–November 2	Oklahoma City, Oklahoma	Basic (1)
November 16–18	Denver, Colorado	OOE (TENTATIVE)

CODES

CAR Cardiology Theme

NEU Neurology Theme

OOE Ophthalmology-Otolaryngology-Endocrinology Theme

(1) A 4½-day basic AME seminar focused on preparing physicians to be designated as aviation medical examiners. Call your Regional Flight Surgeon.

(2) A 2½-day theme AME seminar consisting of aviation medical examiner-specific subjects plus subjects related to a designated theme. Registration must be made through the Oklahoma City AME Programs staff, (405) 954-4831.

(3) A 3½-day theme AME seminar held in conjunction with the Aerospace Medical Association (AsMA). This seminar is a new Medical Certification theme, with 9 aeromedical certification lectures presented by FAA medical review officers, in addition to other medical specialty topics. Registration must be made through AsMA at (703) 739-2240. A registration fee will be charged by AsMA to cover their overhead costs. Registrants have full access to the AsMA meeting. CME credit for the FAA seminar is free.

(4) This seminar is being sponsored by the Civil Aviation Medical Association (CAMA) and is sanctioned by the FAA as fulfilling the FAA recertification training requirement. Registration will be through the CAMA Web site: www.civilavmed.com.

The Civil Aerospace Medical Institute is accredited by the Accreditation Council for Continuing Medical Education to sponsor continuing medical education for physicians.

Addison's Disease in an Aviator

Case Report, by Hans C. Bruntmyer, DO, MPH

Addison's disease is an adrenocortical insufficiency caused by dysfunction or damage to the entire adrenal cortex. It affects glucocorticoid and mineralocorticoid function, thus affecting the body's energy production, ability to handle stress, and the immune system's inflammatory response. Mineralocorticoids, such as aldosterone, help maintain the balance of sodium, potassium, and water. In the United States, Addison's disease occurs in 40-60 cases per 1 million with preponderance for females age 30-50 years. Since this condition can affect electrolytes and energy production, it is of aeromedical concern.

History

A 44-year-old white male U.S. Air Force pilot with over 5,000 flight hours, who is usually in great physical condition, is brought in to your clinic while being assisted by two other pilots. He is holding a gallon-size zip-lock bag, half-filled with emesis and is in obvious distress.

The patient relates he has not eaten in about seven days, is unable to keep fluids down, and he feels incredibly drained. He has had no ill contacts, and no one else is sick who ate with him during his last meal. In addition to non-bloody vomiting, he has nearly passed out when standing quickly, does not feel like eating, and has lost about 20 pounds. He also complains his back and extremities ache. He denies diarrhea. While you are seeing him, he seems to be irregularly terse and irritable.

The patient's medical, surgical, and family history are all negative. Last year, he was deployed to South America in areas endemic for malaria, but he faithfully took his medications while there and during his post-deployment regimen as well. He is a non-smoker and only occasionally drinks alcohol. His blood pressure is 88/42 mmHg, pulse rate is 110 bpm, respiratory rate is 22, temperature 102°F, and his pulse oximetry reading is 94% on room air. During your exam, you note the pilot is alert and oriented to person but not to place or time. He is rather diffusely tan for the time of year (December)

and there is skin tenting. His mucous membranes are dry, and his eyes appear sunken without scleral icterus. There is no acetone odor on his breath, and his lips appear slightly cyanotic. The cardiovascular exam reveals tachycardia and capillary refill of five seconds. His lungs are clear, and he has diffuse non-focal abdominal tenderness without guarding or rebound.

You begin IV hydration, obtain tubes of blood, give IV anti-emetics, and arrange to transport him to the emergency department after calling ahead for a patient report. He is also given oxygen via nasal cannula.

His fingerstick blood sugar is 60 mg/dl, so he is given an ampule of D50 IV. During his transport to the ED, he becomes more confused and briefly loses consciousness. In the ED, his electrolytes are significantly abnormal, including a potassium level of 6.8 meq/l. An ECG is quickly done and the appropriate hyperkalemia treatment is initiated.

The combination of skin darkening, vomiting, hypotension, loss of consciousness, hypoglycemia, myalgias, fatigue and hyperkalemia indicate the patient is likely having an acute adrenal insufficiency or Addisonian crisis.

Aeromedical Concerns

The Air Force states that Addison's disease (AD) is a disqualifying condition for aviation duties, and the USAF Aeromedical Waiver Guide specifically

states that aviators who are undergoing treatment with glucocorticoids are not considered for a waiver, and medical conditions requiring standing (long-term) doses of glucocorticoids are not generally considered stable or waivable" (6). Addison's disease makes an airman ineligible for civilian medical certification under Title 14, Code of Federal Regulations 67.113(b), 67.213(b), and 67.313(b).

Outcome

The pilot in this case did not receive a waiver from the Air Force and was placed in a non-flying billet. He was granted an Authorization for Special Issuance by the FAA for a first-class medical certificate under 14 CFR 67.401 (3). The FAA did require regular follow-ups with his treating physician, with copies of his lab work being forwarded for review.

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ADDISON'S DISEASE ETIOLOGY

ADDISON'S DISEASE (AD) was first described by Thomas Addison in 1855 and is an adrenocortical insufficiency due to dysfunction or damage to the entire adrenal cortex. It affects glucocorticoid and mineralocorticoid function (4). Glucocorticoids, such as cortisol, affect the body's energy production, help handle stress, and play a role in the immune system's inflammatory response. Mineralocorticoids, such as aldosterone, help maintain the balance of sodium, potassium, and water (5). The onset of disease usually occurs when 90% or more of both adrenal cortices are dysfunctional or destroyed. In the United States, AD occurs in 40-60 cases per 1 million, mostly females. The typical age on onset is 30-50 years old.

Morbidity and mortality associated with AD is usually due to failure or delay in making the diagnosis and a failure to begin adequate glucocorticoid replacement. Adrenal crisis is an endocrine emergency, and death may result if treatment is not started promptly. Even after diagnosis and treatment, the risk of death is more than doubled for patients with AD. The higher mortality rate is typically due to cardiovascular, malignant, and infectious diseases.

Addison's disease may present either in the chronic or acute form. Chronic adrenal insufficiency has an insidious onset, and the presentation is dependent on the severity of the defect. Patients typically present with nausea, emesis, weakness, fatigue, weight loss, and poor appetite. There may be hyperpigmentation of the skin and mucous membranes caused by the stimulant effect of excess adrenocorticotrophic hormone (ACTH) on the melanocytes to produce melanin. Patients may experience dizziness with orthostasis due to hypotension, which occasionally may lead to syncope. This is due to the combined effects of volume depletion,

loss of the mineralocorticoid effect of aldosterone, and loss of the permissive effect of cortisol in enhancing the vasopressor effect of the catecholamines. Myalgias and flaccid muscle paralysis may occur due to hyperkalemia. Impotence and decreased libido may occur in male patients; female patients may have a history of amenorrhea.

The acute presentation of AD has similar nonspecific characteristics but may be more severe in onset. The patient may have vascular collapse with shock and appear cyanotic and confused or comatose. Abdominal symptoms may take on features of an acute abdomen with pyrexia (temperatures reaching 105° F or higher) clouding the diagnostic picture. A potentially overlooked symptom of AD is depression and, if the disease is left unchecked, psychosis (1).

The most common cause of AD, accounting for more than 80% of the cases, is idiopathic autoimmune adrenocortical insufficiency resulting from autoimmune atrophy, fibrosis, and lymphocytic infiltration of the adrenal cortex, usually with sparing of the adrenal medulla. Virtually 90% of cases of AD are caused by idiopathic autoimmune adrenocortical atrophy and tuberculosis. Common causes of acute Addison disease include stress, bilateral adrenal hemorrhage, inadequate steroid dosing, bilateral adrenal artery emboli and bilateral vein thrombosis, and bilateral adrenalectomy.

The rapid ACTH stimulation test is the most helpful test. After obtaining blood for a baseline cortisol values, 250 mcg (0.25 mg) dose of synthetic ACTH (1-24 amino acid sequence) is administered IM or IV. Thirty or 60 minutes after the ACTH injection, another cortisol blood samples is drawn. The baseline and 30-minute samples usually are adequate to establish the diagnosis (4).

Other lab tests that are recommended in the workup of AD include an ACTH level (to differentiate primary from secondary insufficiency), a complete blood count (CBC), comprehensive metabolic panel, and thyroid-stimulating hormone (TSH). If there is concern for TB, a chest X-ray and PPD may help. If autoimmune AH is suspected, no imaging is needed; otherwise, an abdominal CT scan may be useful based on the patient's history. If secondary adrenal insufficiency is diagnosed, an MRI of the patient's sella should be done. Due to the cardiac effects of hyperkalemia, an electrocardiogram is encouraged (4).

During an adrenal crisis, the most appropriate treatment is administration of IV glucocorticoids. Treatment should not be delayed while waiting for test results to return. The patient may be given dexamethasone 4 mg IV prior to ACTH test, as it does not interfere with the results. An infusion of isotonic sodium chloride solution should also be started to reinstate volume deficit and correct hypotension. Glucose supplementation may also be required since hypoglycemia may be caused by increased insulin sensitivity (2). "Administer 100 mg of hydrocortisone in 100 cc of isotonic sodium chloride solution by continuous IV infusion at a rate of 10-12 cc/h. Infusion may be initiated with 100 mg of hydrocortisone as an IV bolus" (4). Another method of hydrocortisone administration is 100 mg as an IV bolus every 6-8 hours. As the patient improves, the hydrocortisone infusion can be tapered to daily oral replacement doses.

Other issues important to the care of the patient include the consultation with an endocrinologist. Patients should be counseled about the possible need to increase salt intake in hot weather and to adjust their steroid replacement doses during significant stressful circumstances (4,5). Patients should wear an emergency medical alert bracelet.

About the Author

LtCol Hans C. Bruntmyer, DO, MPH, is board-certified in Emergency Medicine and was a resident in Aerospace Medicine when he wrote this case report at the Civil Aerospace Medical Institute.



Do Not Ignore Certificate Eligibility Warning

By Harriet Lester, MD

Below: Screen shot of Actual Certificate Eligibility Warning

Certificate Eligibility Warning

Due to one or more of the following issue(s) related to this applicant, the FAA recommends that you do not issue a medical certificate or Student Medical Certificate. The potential issues include:

- Previous exam denial
- Prior exam submitted within the past 90 days
- Pending legal action

For additional information, please contact Medical Certification at (405)954-4821.

THERE IS ONLY instance in which an aviation medical examiner receives a clear-cut, formal warning in the Aerospace Medical Certification Subsystem (AMCS) not to issue a certificate. That is when the words “Certificate Eligibility Warning” appear on the screen. You cannot print a certificate through AMCS when this warning is present.

If you see this, call the Aerospace Medical Certification Division or your Regional Flight Surgeon’s office. You should not ignore this warning.

*Dr. Lester is the Eastern Regional Flight Surgeon.
Jana Weems assisted with this article.*

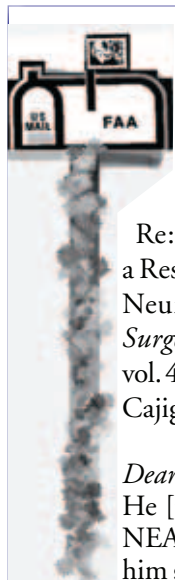
We strongly recommend that all AMEs log in to AMCS and check for the Certificate Eligibility Warning before issuing the medical certificate. It appears on the Medical Certificate Quick Print Screen, Page 2 of data entry, and Page 3 of data entry.

Examples that require this warning include: denial of the previous exam, another exam within the last 90 days, and/or pending legal action.

A medical certificate issued in error causes havoc and potentially endangers the National Airspace System. The

certificate must be retrieved, and if we discover the error after 60 days, a legal enforcement action (suspension or revocation) may be required if the airman does not voluntarily return the certificate for cancellation.

To summarize, please contact the Aerospace Medical Certification Division or your Regional Flight Surgeon when you see the Certificate Eligibility Warning—and do not issue a certificate on your own.



Letter to the Editor

Re: “Monocular Vision as a Result of Traumatic Optic Neuropathy,” *Federal Air Surgeon’s Medical Bulletin* vol. 49, no. 3, p. 10, by Arthur Cajigal, DO.

Dear Editor,

He [the patient] had 20/50 NEAR vision; why not have him get some “cheaters” and forgo the medical flight test? Maybe the typist meant FAR vision 20/50 without correction.

Robert Greer, DO
Lake Park, Fla.

Dear Dr. Greer,

The medical flight test is being administered for monocularity, not for defective near vision. The information was not given in the article, but presumably the airman’s near vision corrects just fine. If the near vision in the remaining eye were to not correct to standards, then technically a medical flight test would also be required for that condition. However, the article is not clear in that context, and this may be what triggered your question.

Courtney Scott, DO, MPH
Deputy Manager, Aerospace Medical Certification Division

FAA Remembers Audie Davis

The former manager of the Aerospace Medical Certification Division, **Audie Davis**, MD, passed away on October 25, 2011, at the age of 80. Dr. Davis had managed the certification division for 30 years before he retired in 1996.

He was recognized internationally as a leader and innovator in aeromedical certification.

Tetralogy of Fallot in a New Airman

Case Report, by Geoffrey L. Ewing, DO, MOH

Airmen with tetralogy of Fallot were often diagnosed postnatally and received surgery at an early age. Often, they have no symptoms or physical limitations well into adulthood. However, survival rates are lower for matched populations, and risks for sudden cardiac death and right ventricular failure are high. Pulmonic insufficiency often develops and requires valve replacement. A young pilot applicant who is active and without apparent complications may seem like a reasonable candidate for a medical certificate, but careful consideration of surgical and peri-surgical history, historic and current cardiac function testing, history of ectopy and arrhythmia, exercise tolerance, and epidemiological understanding are all necessary to assess the aeromedical risk of an airman with tetralogy of Fallot.

History

A 19 YEAR-OLD, bright, well-spoken applicant for a student pilot certificate presents to your office seeking a first-class medical examination. He is an active young man who played baseball competitively through high school and received excellent grades. He has never recalled any lasting illness, physical limitations, or recurrent health problems but does report a diagnosis of tetralogy of Fallot (TOF), for which he had “fixed with surgery when I was a baby.” He is eager to start his training to be a career airline pilot.

Presently, he claims good exercise tolerance and has no symptoms of chest pain, dyspnea, palpitations, dizziness, or history of syncope episodes. With the exception of a 1/6 systolic ejection murmur, 1/4 diastolic decrescendo murmur at the left upper sternal border, and a well-healed midline sternal scar, his physical exam was normal to include the absence of tachypnea, crackles, jugular venous distention, clubbing, cyanosis, or edema. He takes no medications, has a negative family history for sudden death and cardiac, congenital, or blood disorders. He does not use alcohol, tobacco, or illicit drugs, and he lives on a farm with his family in the Midwest United States.

His disease history revealed that at birth, he became mildly cyanotic and had a heart murmur. He was diagnosed with tetralogy of Fallot and at six months underwent a complete repair with a ventricular septal defect

patch and transannular patch at the infundibulum to relieve his right ventricular outflow obstruction. He had no perioperative polycythemia, and post-operatively he had normal ventricular function. Through childhood and his early teens, he had normal ECGs, chest X-rays, and echocardiograms, as well as periodic Holter studies and exercise tolerance tests. After 14 years of age, he neglected follow up until a few months ago.

At this visit, your applicant presented several current reports. His ECG revealed a normal sinus rhythm, heart rate of 84, and a right bundle branch block. His echocardiogram showed no atrial or ventricular shunting, low normal right ventricular systolic function, normal left ventricular systolic function, no pulmonary stenosis, and free pulmonary insufficiency. His cardiac MRI revealed moderate-to-severe pulmonary insufficiency, with 50% regurgitation, and a dilated right ventricle: 234 ml (66 - 240 ml). With this history and these studies, you do not issue a medical certificate and defer the case to the Aerospace Medical Certification Division (AMCD).

Aeromedical Concerns

Arrhythmias, hemodynamic compromise, and impairing medication side effects are aeromedical issues facing airmen with TOF. Once thought to be a definitive procedure, surgery at an early age does not cease the evolution of the disease. Over time, chronic pulmonary valve insufficiency, obstruction

Tetralogy of Fallot

Tetralogy of Fallot (TOF) is a congenital heart malformation that includes a high-riding ventral septal defect (VSD), an aorta that overrides the VSD, right ventricular outflow tract (RVOT) obstruction (hypertrophic infundibular musculature and/or pulmonic stenosis), and subsequent right ventricular dilation and hypertrophy. TOF occurs in 10% of all congenital heart defects and is the most common cyanotic heart defect. It occurs in approximately 1 in 3,600 live births¹⁴ and is without known environmental or genetic associations. Diagnosis of TOF is usually made within the first year of life, and the VSD and RVOT obstructions are surgically repaired. The major long-term complication of tetralogy of Fallot repair is the development of pulmonary valve insufficiency, which can lead to right heart failure and the need for pulmonic valve repair or replacement. Additionally, atrial and ventricular arrhythmias and sudden cardiac death also occur.

of the right ventricular outflow tract, depressed right ventricular function, residual ventricular septal defect leaks, and arrhythmias develop.¹⁻³ Arrhythmias and sudden cardiac death are the most apparent aeromedical concerns, with congestive heart symptoms and failure becoming more likely as the disease progresses with age. Supraventricular tachycardia or atrial flutter occurs in 10%, ventricular tachycardia in 10-15%.⁴ Sudden cardiac death, principally from ventricular tachycardia, is 0.46% per year; after 25 years, it rises to 0.94%.⁵

Survival for unrepaired TOF has a rate of 11% at age 20, 6% at age 30, and 3% by age 40.⁴ If repaired, the 40-year survival rate is projected to be 90%.⁶ Lower survival rates were found with variants of TOF that included pulmonary atresia, presence of associated branch pulmonary

Continued on page 12

Tetralogy from page 11

artery stenosis, or atrioventricular septal defects.⁶ Other factors that conferred a poorer late outcome include surgery after age 12 years,^{5,7} surgery prior to 1970, perioperative polycythemia, and repair requiring a right ventricular outflow patch.⁵ In another study, risk factors for a poor late outcome included preoperative heart failure, persistent right ventricular systolic hypertension, residual right ventricular dysfunction, and residual ventricular septal defect. In the same study, sudden cardiac death appeared to be related to surgical repair at an older age, right ventricular volume, and/or pressure overload, right ventricular dysfunction, and pulmonary insufficiency.⁸

Annual screening for factors leading to arrhythmias, heart failure, and sudden cardiac death are recommended and include an evaluation by an adult congenital heart disease-trained cardiologist, ECG, echocardiography, and MRI. Positive findings on these studies or symptoms (palpitations, dizziness, or syncope episodes), would further prompt an electrophysiology study or hemodynamic catheterization and potentially lead to further interventions such as valve or septal surgery, ablation, or implantation of a pacemaker or cardioverter defibrillator.⁹

Considering that even airmen that have none of these worse prognostic factors will still have a lower survival than age- and sex-matched populations and that sudden cardiac death will occur in a third to one-half of TOF cases, the aeromedical risk of sudden incapacitation or subtle decrement is high.^{10,11} Janicke has published that, an asymptomatic and fully active airman operated on prior age 12 and without hemodynamic abnormalities, is acceptable under the 1% rule for limited certificates under Joint Aviation Requirements (JAR) used by European states. He does not recommend an unrestricted certification; only an operational multicrew limitation Class I (valid only as or with a qualified copilot) and an operational safety limitation

Class II (valid only with safety pilot and in aircraft with dual controls) certificate should be considered.¹²

Outcome

The AMCD's review of this airman's case highlighted the recent findings of free pulmonic insufficiency and a severely dilated right ventricle; thus, they did not issue a medical certificate. His case was referred to the FAA consultant for cardiology, who recommended that the airman be further evaluated by a specialty center with adult congenital heart disease-trained cardiologists. The airman subsequently underwent surgery to receive a bioprosthetic pulmonic valve. His reevaluation six months later demonstrated only traces of pulmonic insufficiency, normal outflow tract characteristics, normal right ventricular function and pressure, and slightly improved volume. With no other complications and improved hemodynamics, he applied again for a first-class student pilot certificate. His case is currently being reviewed by the consultant for cardiology. Factors considered will be the airman's risk of sudden cardiac death, progression of right ventricular function, bioprosthetic valve durability,¹³ the previously mentioned prognostic factors, medical therapy requirements, and recertification requirements. [We hope to report the final outcome in the next issue of the *Bulletin*—Ed.]

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