Chapter 11

DRUGS AND THE FLIER

There are few, if any, drugs which are not of importance in relation to flying duty, and particularly to a pilot. The use of drugs by flying personnel usually becomes a problem when adequate medical administrative control is not exercised by the Flight Surgeon or when airmen have not received adequate medical indoctrination. It is the Flight Surgeon's responsibility to take the necessary steps to see that no one flies as an aircrew member while under medication which might impair flying efficiency.

The Flight Surgeon must keep well informed on all drugs, particularly newly accepted ones, so that no medication will be prescribed which might compromise flying safety. Individual susceptibility to drugs in general must always be considered. The Flight Surgeon is responsible for the proper medical indoctrination of airmen with respect to drugs. He must continuously see to it that his airmen perform flying duty only when in good physical condition and under no adverse influences. He must make them realize the dangers of using certain drugs when flying and the danger of self-medication.

When new drugs receive popular acclaim in various periodicals, it becomes necessary for the Flight Surgeon to see that the flying personnel are thoroughly indoctrinated regarding, these drugs. This is particularly true of new medications containing depressants, some of the more powerful analeptics, the antihistamines, the atropine-like compounds, and other drugs affecting the psychomotor and sensory functions.

Among drugs used in self-medication, antihistaminics may be particularly dangerous if used indiscriminately. A marked individual response is shown to antihistaminics. varying from no effect in some persons to drowsiness, and even severe depression, in others. These drugs depress the vestibular apparatus and decrease depth perception, thus creating a great hazard to personnel attempting to fly while using them.

Nasal decongestants should also be administered carefully. Due to the marked absorptive power of the nasal mucosa, tachycardia and nervous states, including tremors and incoordination may occur if nasal decongestants are used indiscriminately. Mydriasis may also be caused by these drugs, and again a hazardous situation is present. Care must be exercised in the use of certain drugs for prophylactic purposes, which may be considered harmless in smaller dosages.

Prophylactic drugs, such as some of the antimalarials, frequently cause visual difficulties. Quinine and other drugs of the cinchona group given in relatively small doses, frequently cause tinnitus and deafness, the latter being an individual response to the drug. The use of atropine-like substances, such as hyoscine, which is frequently found in preparations used to treat the common cold and is also the main ingredient of some airsickness pills, and antispasmodics, used in ulcer symptoms, will cause sufficient mydriasis and cycloplegia to be dangerous.

The use of chloroquine-primaquine has been approved for malaria prophylaxis in flying personnel who are operating in endemic malaria areas. Although the possibility of adverse reactions is slight with recommended prophylaxis doses, the Flight Surgeon should be fully cognizant of the potential undesirable effects. Pretesting of crewmembers has been recommended.

One of the most important groups of drugs in medicine is the antibiotic group. There is frequently a tendency to use them indiscriminately. Of these, two may be very dangerous to flying personnel—namely, streptomycin and dihydrostreptomycin. Both of these drugs may cause permanent hearing and vestibular damage, but dihydrostreptomycin does not give a warning of dizziness as does streptomycin. It is strongly recommended that neither of these drugs be given to flying personnel when another drug will do the job. If used, as for example against H. Influenzae, thorough hearing and vestibular testing should be done before starting therapy and weekly during the therapy. The therapy should be stopped immediately if any decrease in function occurs, unless the drug is necessary to save life.

Chloramphenicol has been shown to have an adverse effect on the hemopoietic system. It may occasionally cause aplastic anemia. Because of this action on the hemopoietic system, it may decrease the oxygen transport, and thus its use in flying personnel should be carefully controlled.

Various other drugs tend to decrease tolerance to hypoxia. Carbonated alkalizers taken in large amounts or too frequently, tend to cause the formation of methemoglobin, as do acetanilid and phenacetin.

Special consideration must also be given certain drugs which may be used in air evacuation. Since more and more battle casualties and other patients are being transported by air, it becomes necessary for the Flight Surgeon to evaluate the use of drugs in flight which would not ordinarily be used by him on flying personnel. For analgesia during flight, it is fairly obvious that morphine, due to its respiratory depression, should be very carefully controlled, if used at all.

The synthetic drugs, such as meperidine, have less effect on respiration. For sedation, the barbiturates should not be used in too large doses, since they may cause a stage of anesthesia deep enough to depress the respiratory center. Chloral hydrate is not advocated, since both respiratory and cardiac depressions are associated with its use. Of the sedatives, paraldehyde is probably the best, causing no depression of either respiration or heart function.

The factors which most frequently modify the action of drugs in flight are *hypoxia* and *fatigue*. A brief discussion follows on drugs in these categories.

Drugs Which Increase Tolerance to Hypoxia

Drugs which increase the partial pressure of oxygen in alveolar air, diminish the oxygen requirement of the organism, or act as respiratory stimulants, may increase tolerance to hypoxia. Such drugs are ammonium chloride, glucose, and analeptics.

Ammonium Chloride

It has been demonstrated that 10 to 20 gm of ammonium chloride a day for 3 days will increase the arterial oxygen saturation about 10% at 18,000 feet. This results in improved performance and a smaller acceleration of the pulse than expected. The probable mechanism of action is explained by an increase in the exhalation of carbon dioxide with a resulting increase in alveolar oxygen tension. It may be due to a slight shift in the acid-base balance with a resulting change in oxyhemoglobin formation and dissociation. Unfortunately, such doses of ammonium chloride often produce gastrointestinal irritation.

Glucose

Visual and psychomotor tests in humans suggest that the ingestion of glucose improves performance at altitude. There is some evidence that a low blood sugar interferes with oxygenation of the central nervous system so that a mild lack of oxygen may produce symptoms which would not occur with normal blood sugar. The higher alveolar respiratory quotient on a carbohydrate diet also plays a role in decreasing the alveolar carbon dioxide tension. These facts would seem to justify the ingestion of foods rich in carbohydrate, immediately before a high-altitude mission.

Analeptics

Under conditions of hypoxia, amphetamine 10 mg, methamphetamine 5 mg, dextro-

amphetamine 5 mg, or caffeine sodium benzoate 500 mg improve psychomotor performance. There is some evidence that amphetamine is superior to caffeine for this purpose. However, a great deal of evidence shows that amphetamine or dextroamphetamine in therapeutic doses may adversely affect one's judgment. Every precaution should be used when it is administered to flying personnel.

Drugs Alleged to Reduce Tolerance to Hypoxia

If the administration of sulfonamides results in an anemia or methemoglobinemia, or if the subject is abnormally susceptible, there is no doubt that tolerance to hypoxia is reduced. Otherwise, there is evidence that, of the sulfonamides, only sulfanilamide in moderate doses diminishes tolerance to hypoxia. From experiments at sea level, there is evidence that sulfanilamide should not be used when doing exacting or strenuous work. Depth perception and phorias may be adversely affected by sulfathiazole or sulfadiazine.

There seems to be no significant effect on staring and vigilance, dark adaptation, mental efficiency, or eye-hand coordination. There are also no effects on various intellectual and psychomotor functions under hypoxic conditions, or the ability to perform exhausting work. The occasional abnormal toxic response to the sulfonamides may be aggravated by conditions of flight and may be more dangerous because of the exacting demands of the situation.

Drugs for Airsickness

Most airsickness drugs fall into three categories—parasympathetic depressants, central nervous system depressants, or antihistaminics. Drugs that are effective against one type of motion sickness are, generally though not necessarily, effective against the other types as well. As far as can be determined, there is good correlation between drugs and their effectiveness against the sickness produced by various types of motion. To be useful in flying personnel, a drug should diminish the incidence of airsickness; not impair the capacity to perform duties; and not be toxic, habit-forming, or cause disagreeable symptoms. Also, it should be active in a reasonably short time after oral administration.

Depression of the central nervous system renders the barbiturates of doubtful value for flying personnel. In fact, in experiments on the swing and in seasickness, they have not been shown to be particularly effective nor have they appeared to contribute to the beneficial effects of other drugs when used for motion sickness. Those studied include phenobarbital, barbital, amobarbital, and pentobarbital. However, the Army motion sickness preventive, containing sodium amobarbital, hyoscine, and atropine, is effective in swing sickness, seasickness, and airsickness. Whether this is due entirely to its content of hyoscine and atropine has not been demonstrated.

Of the numerous compounds and mixtures tested, those of the atropine series have shown the most substantial protection against airsickness. Because of the high degree of protection and low incidence of side effects, scopolamine has been the most widely used of the antimotion sickness drugs.

In 1949, the report of Gay and Carliner on the effectiveness of dimenhydrinate in seasickness stimulated considerable interest in the use of antihistamines for motion sickness. Yet, subsequent tests showed scopolamine to be still more effective than either dimenhydrinate or diphenhydramine HCl. Since the pharmacological properties of diphenhydramine HCl and scopolamine are not identical, however, a mixture of these two drugs was tested. Hyoscine hydrobromide (0.65 mg) was mixed with diphenhydramine HCl (50 mg). Greater protection was shown with the mixture than with scopolamine alone. A preparation containing half of these components was tested and found to be as effective as the full dose of hyoscine alone, with fewer side effects. Good protection has been afforded by the following preparations, in addition to those already mentioned: Promethazine HCl, chlorpheniramine, cyclizine, and meclizine HCl.

The School of Aerospace Medicine has car-

ried out a very extensive program of testing the various drugs for their effectiveness in controlling motion sickness. Statistically, there is little difference in the effectiveness of the conventional drugs, such as cyclizine, dimenhydrinate, meclizine HCl, and promethazine HCl. The actual choice of drugs to be used is dependent almost entirely upon individual differences in the response of the patient to the drugs.

None of the drugs mentioned above has been demonstrated to be safe for use by aircrew members. However, on occasion, they may be used in the early training period of cadets and officers training in grade, provided the student is not in primary control of the aircraft. The use of these drugs, therefore, will be limited to dual instruction periods and will be carefully controlled by the Flight Surgeon. Extreme care must be taken with regard to preliminary testing to avoid unusual reactions which may occur as a result of hypersensitivity of a person. In addition, the instructor pilot must be properly notified and indoctrinated concerning the use of the airsickness preventive by the student.

The use of the drugs should never be prolonged but should be limited to a relatively short training period, as a means of supporting the person during a period of 3 or 4 weeks when he is developing a resistance to the effects of motion. The Flight Surgeon must take particular care in assuring that proper control of the use of these drugs is enforced and that unauthorized use of them by the student is prevented.

Drugs for Fatigue

Men can postpone sleep and fatigue and remain alert to carry on their duties for many hours longer than they would normally if they receive dextroamphetamine at appropriate intervals. This drug is not habit-forming in the sense that physical signs of withdrawal are produced. However, many find the stimulation pleasant, and excessive use may occur. Overdosage will produce excessive excitement, headache, and sleeplessness. Some people are unusually susceptible to the actions of this drug. It is no substitute for rest or sleep, but merely postpones the need for it.

If a drug of this nature is felt to be necessary for mission completion, then it is an admission that the flight exceeds the capability of the fliers. Accordingly, mission replanning is indicated rather than reliance on medication which may have unpredictable results.

AIR FORCE POLICY

The Surgeon General, United States Air Force, does not interfere with the privilege each physician has to practice good medicine. With particular reference to drugs, there has been practically no dictation to the practitioner as to what drugs will or will not be used. However, it has been and is now Air Force policy that, *in general,* no drugs will be used by an individual while on flying status.

Flight Surgeons must be especially alert to detect self-medication and must take steps to insure that drugs are not being given to flying personnel either through self-medication or by allied medical service personnel who are not Flight Surgeons. The Flight Surgeon can do much to control the latter through the establishment of adequate rapport and liaison with other medical service personnel, such as ward officers and dentists, so that the Flight Surgeon is informed when flying personnel are being treated by them.

The use of antihypertensives, anticholinergics, antihistaminics, tranquilizers, and sedatives is fraught with *considerable* risk and their use by personnel on flying duty is contraindicated. The indications for the use of these and other drugs in general are sufficient cause in themselves for removal from flying status.

DRUG USE AND ABUSE

A number of foreign countries do not have limitations as strict as those of the United States on the type of drugs that can be purchased "over the counter" without a prescription. Prolonged or frequent use of cer-

tain items available under foreign laws can cause personal harm and create disciplinary problems. Some of the preparations, which are sold under various brand names, are barbiturates and amphetamines. The dangers from the indiscriminate, unprescribed use of these preparations by flying personnel are self-evident.

Although surveys and investigations have disclosed few instances of such drug use and abuse, Flight Surgeons and Commanders must be continuously alert to the possible existence of this problem, particularly in oversea areas. Personnel should be warned of the hazards associated with the purchase and use of drugs from the local market, pointing out that these preparations may contain substances which, under US law and medical practice, are considered harmful and undesirable except when used under the close direction of their physician.

REFERENCES

The reader should insure the currency of listed references.

Ashe, W. F., *Drugs: Are They Friend or Foe of the Aviator?* Proceedings of Aviation Medicine Symposium on Toxic Hazards in Military Flying and in the Aviation Industry, Headquarters Air Materiel Command, 1957.

Armstrong, H. G., *Aerospace Medicine,* Chapter 26, "Aircrew Maintenance," The Williams and Wilkins Company, Baltimore, 1961.

Cutting, W. C., *Guide to Drug Hazards in Aviation Medicine,* Federal Aviation Agency, Aviation Medical Service, 1962.

Effects of Chloroquine on the Speed of Visual Accommodation in Man. USAF School of Aviation Medicine Project No. 21 1601–005, 1953.

Gay, L. N., and Carliner, P. E., *The Prevention and Treatment of Motion Sickness: I. Seasickness.* Science, 109:359, 1949.

Glorig, A., *The Effect of Dihydrostreptomycin Hydrochloride and Sulfate on the Auditory Mechanism.* Annals of Otology, Rhinology and Laryngology 60:327–335 (1951).

Greenwood, G. J., *Neomycin Ototoxicity.* Archives of Otolaryngology 69:390–397 (1959).

Haas, W. R., *Anti-Malarial Drugs in Flying Personnel,* Journal of Aviation Medicine. February 1955.

Leake, C. D., *The Amphetamines and the Sleepy Driver.* Ohio Medical Journal 176–178, 1957.

Lett, J. E., *Nasal Vasoconstriction in Flying.* USAF, Medical Service Digest, Volume III, No. 5, July 1952.

Naunton, R. F., and Ward, P. H., *Ototoxicity of Kanamycin Sulfate in the Presence of Compromised Renal Function.* Archives of Otolaryngology 69:398–399 (1959).

Smith, G. M., and Beecher, H. K., *Amphetamine, Secobarbital, and Athletic Performance: II. Subjective Evaluations of Performances, Mood States and Physical States.* Journal of American Medical Association 172:1502–1514, 2 April 1960.

Smith, G. M., and Beecher, H. K., *Amphetamines, Secobarbital, and Athletic Performance: III. Quantitative Effects on Judgment.* Journal of American Medical Association 172:1623–1633, 9 April 1960.

Shambaugh, G. E., Jr., *et al., Dihydrostreptomycin Deafness.* Journal of American Medical Association 170:1657–1660 (1959).

Waters, R. O., *Ototoxic Drugs.* USAF Aerospace Medical Center, School of Aviation Medicine Review 5–60, October 1960.

Wittmer, J. F., *Aeromedical Aspects of Malaria Prophylaxis with Chloroquine-Primaquine,* Aerospace Medicine, October 1963.