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DIZZINESS AND VERTIGO IN AVIATORS

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FOREWORD

This report was prepared in the Ear, Nose, and Throat Branch under task No. 775508. The period covered by this report was 1 January 1960 to 1 January 1966. The paper was submitted for publication on 2 May 1967.

This report has been reviewed and is approved.

JAMES B. NUTTALL
Colonel, USAF, MC
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ABSTRACT

The medical records of 84 patients referred to the USAF School of Aerospace Medicine because of vertigo or diseases which are capable of producing vertigo are reviewed, and the findings and aeromedical disposition are analyzed. Approximately one-third of the patients evaluated in this series fell into the category of vestibular neuronitis. The remaining categories in order of decreasing frequency were Meniere's disease, idiopathic paroxysmal vertigo, labyrinthine or central nervous system ischemia, trauma, barovertigo, and vertigo suspected to be due to neoplasm. Ten of the patients in this study were thought to have "lightheadedness" of nonvestibular origin.

DIZZINESS AND VERTIGO IN AVIATORS

I. INTRODUCTION

Many excellent studies have been conducted both in the basic physiology of the labyrinthine and central nervous systems and in the clinical aspects of diseases which produce dizziness or vertigo. This information has added much to our understanding of the diseases which may produce vertigo and has led to excellent discussions of the differential diagnoses and diagnostic aids (1, 5, 6, 10, 20-23). Specific findings such as positional nystagmus and postural vertigo have been amply discussed by several authors (3, 8, 15), and differential diagnostic classifications for symptoms sometimes associated with vertigo have also been offered to assist in making a diagnosis.

Although it is generally accepted that vertigo occasionally occurs during attacks of otitis media, transient vertigo due to barotitis media was thought, until recently, to be relatively rare. A recent review of the literature and an interview study of divers (16) and of 108 Swedish RAF aviators (17) revealed a much higher incidence than was expected; 18 of the 108 aviators interviewed had experienced the phenomenon. These papers discuss the theoretic relationship of vertigo to pressure phenomena within the middle ear.

Cases of vertigo described as epidemic vertigo (4, 14, 19), vestibular neuronitis (6), or toxic labyrinthitis (5) seem to be related to isolated or epidemic infectious disease or to drug ingestion. The nomenclature and pathogenesis of these disorders are still controversial; however, the precipitating factors, prognosis, pathogenesis, and area of involvement are considered by some (10) to be the same. For these reasons, patients with the diagnosis of toxic labyrinthitis or vestibular neuronitis will be discussed as a single group in this report.

This study constitutes a review of the findings and aeromedical disposition of 84 patients who were referred to the USAF School of Aerospace Medicine because of vertigo or diseases which are capable of producing vertigo and whose evaluation or re-evaluation was accomplished during the period 1 January 1960 to 1 January 1966.

II. METHODS

A complete medical evaluation was accomplished on each of these patients. Although tests and consultations were individualized, the typical patient was seen in the Neurology Branch where a complete neurologic examination and routine electroencephalogram (EEG) were obtained with other tests performed if indicated. The Ear, Nose, and Throat evaluation consisted of a complete ENT physical examination, and audiometric, caloric, and rotational vestibular tests. Caloric tests utilized were either the modified Kobrack (18) or the Fitzgerald-Hallpike technic (9). Routine audiograms consisted of pure-tone air and bone conduction, speech reception threshold (SRT), and speech discrimination. Loudness balance, short-increment sensitivity index (SISI), Bekesy sweep frequency, threshold decay, distorted speech, and other tests were obtained when indicated. The Internal Medicine evaluation consisted of a physical examination and routine electrocardiogram (ECG). Special studies were obtained when indicated, such as tilt table, single and double Master's ECG, glucose tolerance ECG, precordial map, phonocardiogram, vectorcardiogram, 3-day blood pressure check, automatic blood pressure recording, pulmonary functions with and without

walking ventilation, treadmill, ballistocardiogram, plethysmogram, total body water, total blood volume, and cardiac output. Psychiatric evaluation and psychologic testing were requested when necessary. The routine ophthalmologic examination consisted of gross external examination including pupil reactions, heterophoria measurements, cover test, refraction, accommodation, color vision, depth perception, near point of convergence, biomicroscopy, ophthalmoscopy after mydriasis, intraocular tensions, fundus photographs, red lens test, and near and distant visual acuity. A dental examination was conducted routinely, and evaluation in the Surgery Branch was accomplished when indicated. Routine radiologic evaluation of these patients consisted of skull, chest, and kidney, ureter, and bladder (KUB) x-rays. Internal acoustic meatus, cervical spine, paranasal sinuses, cardiac, and other studies were obtained if necessary. Routine laboratory determinations included glucose tolerance, complete blood count (CBC), Venereal Disease Research Laboratories test (VDRL), urinalysis, and urine culture.

Several of the subjects in this series did not admit symptoms suggestive of true rotational vertigo although they had been referred because of vertigo or vertigo-producing diseases. Unfortunately, conflict in terminology confronts the flight surgeon and his consultants with regard to vertigo. They must differentiate between the symptoms considered to be vertigo arising from diseases that are disqualifying for flying duties and symptoms resulting from contradictory but normal stimuli perceived by the normal brain in the performance of flying duties ("pilot's vertigo"). Vertigo refers to a false sense of motion or position, and this definition can be applied to both the above categories as well as to many other forms of dizziness.

Because of the difficulty in delineating which symptoms should be called true vertigo and which should not, the findings of this study will be presented according to the following outline:

1. Dizziness ("vertigo" or confusion) resulting from contradictory normal stimuli.

   Spatial disorientation.

2. Dizziness ("vertigo" or confusion) resulting from diseases producing contradictory abnormal stimuli or abnormal perception.

   Suspected as being due to:

   a. Paroxysmal vertigo, cause unknown.

   b. Meniere's disease (hydrops of the labyrinth).

   c. Vestibular neuronitis or toxic labyrinthitis.

   d. Physical trauma.

   e. Barotrauma.

   f. Neoplasm.

   g. Labyrinthine or CNS ischemia.

Illustrations depicting symptomatology and pathology are offered according to the method suggested by Feinstein (7).

III. RESULTS

Dizziness ("vertigo" or confusion) resulting from contradictory normal stimuli

Spatial disorientation (or "pilot's vertigo"). This sensation is deliberately experienced by every aviator early in his flying training. It generally constitutes a vague sensation of motion or a faulty sense of "straight and level." The various types of disorientation have been described elsewhere (11, 12, 13). Factors which have been observed to predispose the development of spatial disorientation include:

1. Lack of indoctrination or proficiency.

2. Fatigue or anxiety.

3. IFR conditions or high G maneuvers and speed.

The Coriolis illusion, when experienced in flight or during landing maneuvers, is particularly frightening to the inexperienced aviator or to the aviator who lacks flying proficiency.

In many instances, it is difficult to determine in this type patient whether anxiety is the cause or effect of the spatial disorientation, but the element of anxiety is almost always present. It is important to determine, if possible, why this physiologic phenomenon has become a chronic or recurrent problem emotionally with the individual. Four cases were referred for evaluation of this type of vertigo, and many of the above predisposing factors could be found in all cases.

Dizziness ("vertigo" or confusion) resulting from diseases producing contradictory abnormal stimuli, or abnormal perception

Paroxysmal vertigo, cause unknown. Thirteen patients were found to have had paroxysmal vertigo. The average age of patients in this category was 32 years (range, 24 to 45 years). The average flying time was approximately 3,100 hours (range, 500 to 6,000 hours), and the average length of active duty time was 15 years (range, 3 to 21 years).

All 13 patients experienced episodes of true rotational vertigo. These episodes were intermittent, lasting 1 week to several months, with asymptomatic intervals from a few weeks to a year. None of the patients were symptomatic at the time of evaluation, and they had been asymptomatic for periods varying from a few weeks to 13 months. The positive history and findings are indicated in figure 1.

Re-evaluations were accomplished on 3 patients, including the individual who exhibited EEG abnormality; however, re-evaluation was accomplished approximately 1 month later at another facility while the patient was asymptomatic and did not confirm the EEG abnormality. The second patient was re-evaluated after a 6-month interval. The third patient, re-evaluated after an interval of 19 months, had experienced dizziness (possibly vertigo) about 16 months after his initial evaluation but was otherwise asymptomatic. The latter patient and one of the patients not re-evaluated were followed by means of the survey which was received approximately 6 months subsequent to the initial evaluations. At that time they were asymptomatic and exhibited no changes in audiometric testing from the results which were obtained during the initial evaluations.

Meniere's disease. Only one patient evaluated during this period could unequivocally be said to have Meniere's disease. Fourteen additional patients had symptoms and findings which were somewhat atypical, and in most cases they were diagnosed as having Meniere's syndrome or atypical Meniere's disease. For the purpose of this discussion, however, the latter patients will be included in this category. The average age of patients was 37 years (range, 26 to 54 years). The average flying time was 3,300 hours (range, 1,200 to 7,800 hours), and the average time on active duty was 15 years (range, 4 to 29 years).

Thirteen of the 15 patients in this group experienced attacks of vertigo, ranging from few to many. Two did not have symptoms of typical rotational vertigo, but were included because symptomatology and findings were related to hearing loss. None of the patients were symptomatic at the time of evaluation, although 2 of them had been symptomatic a few days earlier. The asymptomatic period for all patients in this group before evaluation ranged from a few days to 22 months.

Pertinent history and findings are summarized in figure 2. ENT physical examination revealed no significant abnormalities. Audiometric testing revealed unilateral, low-frequency sensorineural deafness in 4 patients; 8 had a high-frequency sensorineural deafness; and 3 had normal hearing. Bekesy tracings accomplished on 6 individuals were either type I or type II. Tone decay tests were noncontributory, and the SISI indicated recruitment in the frequencies of the hearing loss.

Followup evaluation at the USAF School of Aerospace Medicine was accomplished on 6 of the patients after asymptomatic observation periods ranging from 6 to 24 months. One patient who received a discharge physical examination 19 months after his evaluation at the USAF School of Aerospace Medicine was found to have been symptomatic (vertigo) during the interval.

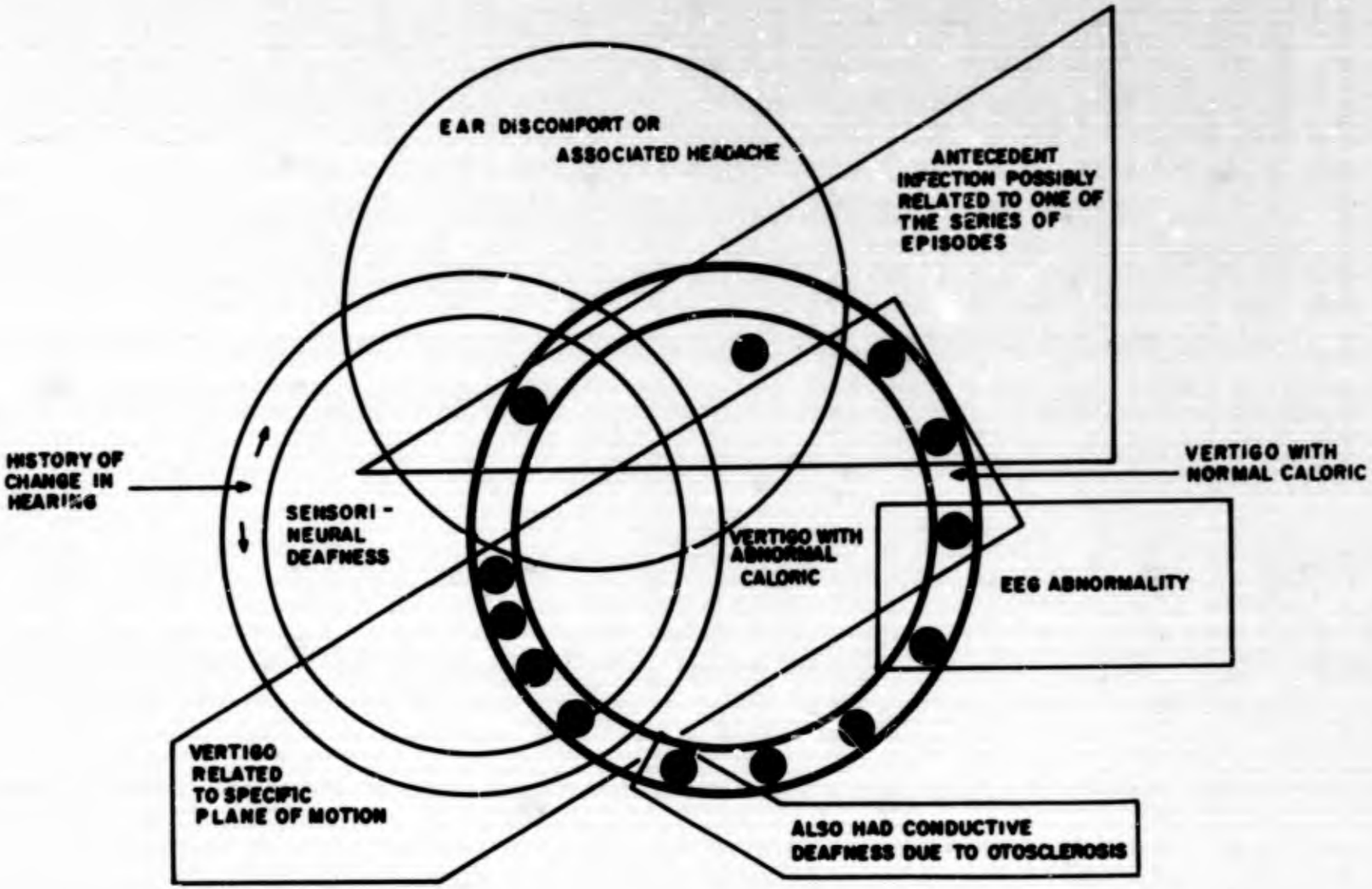

FIGURE 1

Paroxysmal vertigo, cause unknown.

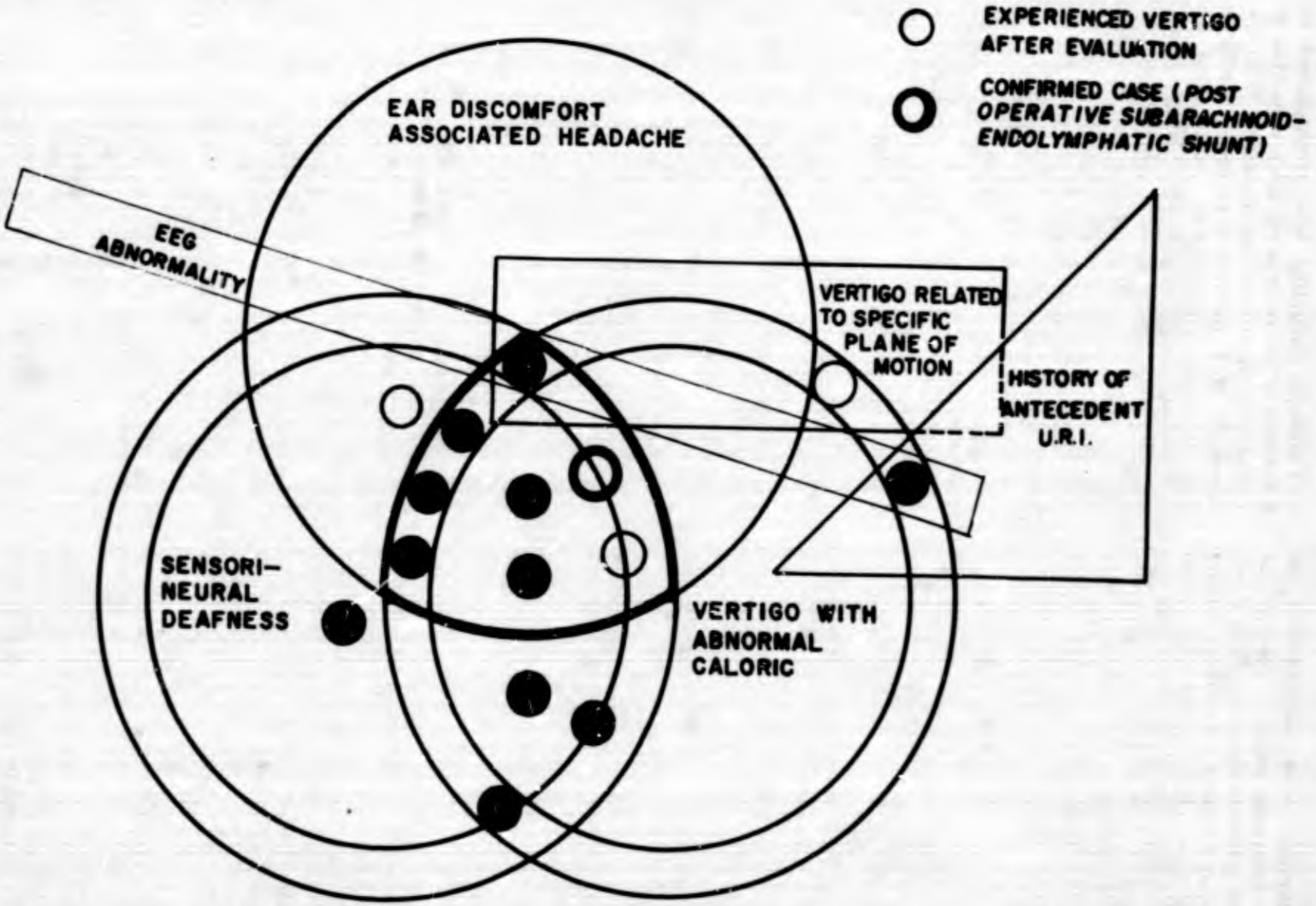

FIGURE 2

Vertigo (or hearing change) suspected to be due to Meriere's disease.

Followup surveys were accomplished on 6 patients at intervals ranging from 7 to 47 months after initial evaluation. Only 2 patients had been symptomatic (vertigo) during the interval. Followup information on 2 of the patients was obtained by both survey and re-evaluation at the USAF School of Aerospace Medicine. Four patients in this category were not re-evaluated and could not be located for survey purposes.

Vestibular neuronitis or toxic labyrinthitis. Twenty-nine patients in this series were suspected of having experienced toxic labyrinthitis or vestibular neuronitis. The average age was 34 years (range, 26 to 46 years). The average flying time was 3,260 hours (range, 1,100 to 5,400 hours), and the average period of active duty was 14 years (range, 2 to 24 years.)

Twenty-five patients in this category experienced true rotational vertigo, and 4 were thought to have had atypical forms of vertigo. Six had only a single episode, while the remainder experienced a few to many intermittent attacks. At the time of evaluation, 4 patients were symptomatic and the rest had been asymptomatic for periods from 1 month to 5 years. History and findings are summarized in figure 3.

ENT physical examination failed to reveal any significant abnormal findings in these patients. Bekesy audiometry performed on 8 patients produced results which were classified as type I or type II. No significant tone decay was noted in any of the patients and the SISI, when performed, indicated recruitment in the frequencies where hearing loss was found.

Of the 8 patients evaluated by means of special films of the internal auditory canal, 1 was thought to have sclerotic and thick canal walls on the left side. Of the 9 patients who had cervical spine x-rays, 1 was observed to have cervical osteoarthritis in the C5-6 area. Routine EEG recordings accomplished on all patients were normal, with the exception of one borderline abnormality.

Followup evaluation was accomplished on 8 patients after an interval from 3 months to 1 year after the initial examination. With the exception of 1 individual returned to flying duty who was subsequently re-evaluated for low back pain, all patients in this category were removed from flying duties during the recommended period of observation. One of these 9 subjects was re-evaluated at another medical facility, and records were obtained for this study after his return to flying duty. All subjects were asymptomatic with regard to vertigo during the interval between initial and secondary evaluations, and 1 subject with abnormal caloric findings was found to have normal responses on re-evaluation. Another subject with initial abnormal caloric findings was found to have a persistence of the abnormality but was asymptomatic.

Followup surveys were obtained on 4 other subjects at intervals of 7, 14, 38, and 48 months, respectively, after initial evaluation. All had been returned to flying duty and were still asymptomatic. One subject died in an aircraft accident (determined to be due to a maintenance error) 3 months subsequent to his evaluation at the USAF School of Aerospace Medicine.

Physical trauma. Three patients were included in this group because of a history of cerebral concussion or skull fracture sustained in a severe accident. Only 1 of them reported rotational vertigo, and the remaining 2 subjects admitted periodic sensations of imbalance. Two patients with possible skull fracture experienced the symptoms immediately at the time of the accident. The third experienced symptoms approximately 6 months after the accident. The latter was found to have spontaneous vertical nystagmus during electronystagmographic recordings before caloric examination. All of the subjects were asymptomatic at the time of the examination. The recommendation at the initial evaluation was that the subjects be grounded for observation or re-evaluation, or both. Re-evaluation has been accomplished on one individual after which he was returned to flying duties with a labyrinthine abnormality apparently compensated. The remaining

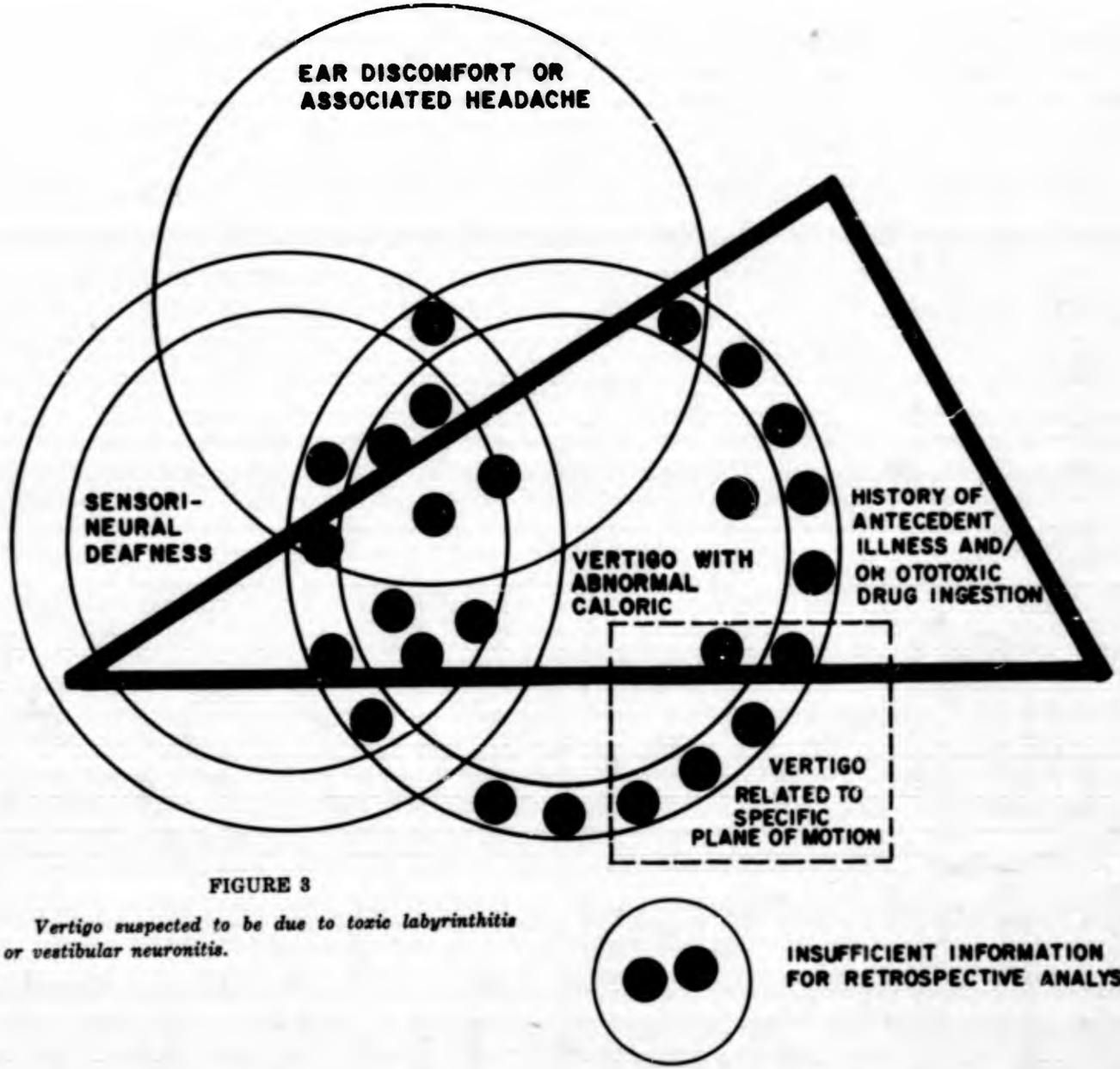

FIGURE 3

Vertigo suspected to be due to toxic labyrinthitis or vestibular neuronitis.

subjects have not been re-evaluated at this time.

Barotrauma. Two subjects are included in this category because the onset of vertigo was related to pressure phenomena in the middle ear. One experienced only vertigo, and the other had vertigo and transient facial nerve paralysis. A review of the literature which included a discussion of the latter patient has been published by Bennett and Liske (2).

Several subjects included in other diagnostic categories in this study reported instances which raised the suspicion of possible barovertigo.

Neoplasm. Only 1 subject in this survey was suspected of having neoplastic disease. This suspicion was not substantiated, and a followup survey 5 years later revealed the patient to be without symptoms relating to vertigo.

Labyrinthine or CNS ischemia. Six patients are included in this group, with an average age of 43 years (range, 35 to 47 years) and average flying time of 4,200 hours (range, 3,300 to 6,000 hours). History and findings are summarized in figure 4.

Re-evaluation of 3 patients revealed them to be asymptomatic with respect to vertigo; however, 1 subject, having vertigo with sudden loss of hearing in one ear, was examined 2 months later and found to have a similar hearing loss in the other ear.

Miscellaneous

Ten subjects evaluated for vertigo or vertigo-producing diseases were interpreted to have only lightheadedness. Two of these subjects were thought to have debility due to some systemic illness and poor physical conditioning; 3 were thought to have had vasomotor instability or presyncope; and 3 were considered to have had anxiety reactions with hyperventilation. Only 3 subjects were found to have mild sensorineural hearing loss consistent with the effects of acoustic trauma. One patient in whom anxiety was a factor related the onset of symptomatology, including transient diplopia, with a change of eyeglasses. His evaluation revealed no significant abnormalities, with the exception of compound myopia, astigmatism, and emmetropia. One patient was referred with the tentative diagnosis of cerebral ischemic attack and, after thorough evaluation, was found to have a cerebral aneurysm.

IV. DISCUSSION

Before determining diagnosis and aeromedical disposition of a case of dizziness or vertigo, the flight surgeon and his consultant should be thoroughly familiar with aviation physiology and occupational medicine as it applies to the aviator. The flight surgeon is subjected to a variety of pressures from the patient who realizes that his career may be in jeopardy. He may have more difficulty than his nonaviation counterpart in obtaining an accurate history because of subconscious (and sometimes deliberate) minimizing of symptoms, or he may obtain an extremely accurate view of every subtle symptom experienced by a trained, intelligent, conscientious, and sometimes compulsive aviator who is concerned with flying safety.

In the former case he may be led astray by the lack of such things as a history of upper respiratory infection or drug ingestion because the patient does not want his flight surgeon to know that he flew with a cold or that he treated himself with prohibited medication. In the latter case, the physician may be confused by such factors as pressure in the ear, tinnitus, antecedent cold, sensorineural deafness (which may actually be due to acoustic trauma), fluctuation of hearing (possibly due to threshold shift), vertigo, imbalance, extreme anxiety concerning the symptoms, and, possibly, family problems. The diagnosis is made even more difficult because of spatial disorientation during performance of aviation duties, which may also be called vertigo by the pilot and may be recounted in the history.

Most physicians, including flight surgeons, experience a feeling of profound frustration

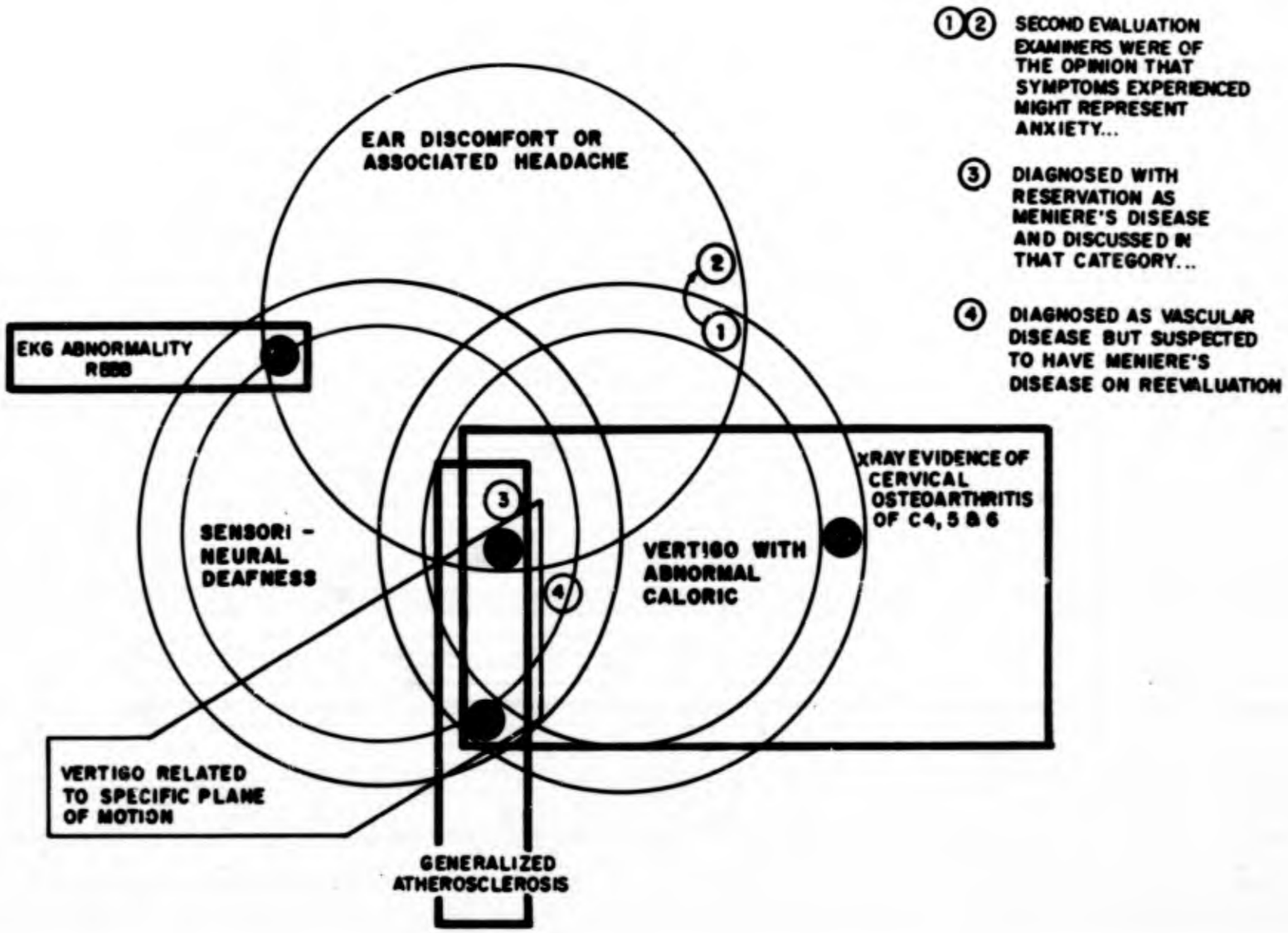

FIGURE 4

Vertigo (or hearing change) suspected to be due to vascular accident.

when a patient complains that he is "dizzy." More than likely, the physician begins by attempting to determine if the patient has experienced vertigo as opposed to a lightheaded feeling. He may feel a certain sense of satisfaction if he discovers that the patient had, in fact, experienced true rotating vertigo; however, a sense of frustration again besets him when he attempts to diagnose the cause of the vertigo. Even if the history offered by the patient is a "classical textbook case," the result is usually the diagnosis of a relatively nonspecific and idiopathic disease entity about which little is known except perhaps the usual prognosis. Often the history is atypical and consists of pertinent ingredients from all diagnostic categories, thus preventing even an approximate diagnosis. The physician is left without his most common and frequently his only advantage, the ability to provide a prognosis. After subjecting the patient to a barrage of specialized tests, in most cases negative or ambiguous results make it necessary to return to the history for diagnosis. A superficial examination of the diagrams representative of many of the categories of this report will reveal that with the exception of the category of suspected labyrinthine or central nervous system ischemia, the history was the most important factor in making the diagnosis or in determining prognosis.

Vertigo is generally classified on the basis of etiology or anatomic location of the lesion. The physician, armed with any of these satisfactory differential diagnostic classifications, finds that in most cases of vertigo the cause may be suspected, but is infrequently confirmed.

In order to maintain combat readiness for world-wide duty in all types of aircraft, current USAF policy states that "recurrent episodes of vertigo" are disqualifying for Flying Class II, which encompasses pilots and navigators. Theoretically, self-limited diseases do not recur; consequently, if the symptoms recur, re-evaluation and waiver action are medically and administratively justifiable prerequisites to returning to flying duties.

When determining aeromedical disposition, the consultant must not be too hasty to state that he feels it is "okay" for the aviator "to return to flying duties." Before making such a statement, in order to fulfill his responsibility to both the United States Air Force and his patient, he should ask himself this question: Do I feel that he is no more likely to develop vertigo than is the average aviator? Each individual case will naturally fall into one of three prognostic groups:

1. The cause is almost certainly a nondisabling disease which is self-limited, and the vertigo is not more likely to recur in the patient than in the average individual. There is probably no hazard to flying safety, and the aviator may be returned to flying after 1 year if there is no recurrence of vertigo. (Examples are toxic labyrinthitis or vestibular neuronitis).

2. The cause is almost certainly a potentially disabling disease which is chronic and possibly progressive, and the vertigo is probably more likely to recur in the patient than in the average individual. A hazard to flying exists. (Examples are epilepsy, vascular disorders, neoplasms, Meniere's disease.)

3. The cause and prognosis are uncertain. Grounding and close medical observation with possible re-evaluation are indicated.

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