Evaluating Dizziness

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PURPOSE: To conduct a structured literature synthesis on the etiology, prognosis, and diagnostic evaluation of dizziness, and to suggest a primary-care approach to evaluating this symptom.
METHODS: Studies were identified from MEDLINE searches (1966 through 1996) and a manual search of bibliographies from retrieved articles. Two investigators independently abstracted study data.
RESULTS: The most common etiologies for dizziness were peripheral vestibulopathies (35% to 55% of patients) and psychiatric disorders (10% to 25% of patients). Cerebrovascular disease (5%) and brain tumors (<1%) were infrequent. The history and physical examination led to a diagnosis in about 75% of patients. At least 10% of patients eluded diagnosis. Symptoms were usually self-limited and not associated with an increased risk of mortality. The diagnostic testing literature, which was often methodologically flawed, suggested that routine laboratory tests as well as cardiovascular and neurologic testing had a low yield in unselected patients. We could not derive evidence-based guidelines for using specialized vestibular function tests such as electronystagmography.
CONCLUSIONS: Dizziness is usually a benign, self-limited complaint. When a diagnosis can be made, a careful history and physical examination will usually identify the probable cause. Cardiovascular, neurologic, and laboratory testing should be guided by the clinical evaluation. Rigorous studies are needed to determine the accuracy and utility of specialized vestibular testing. **Am J Med. 1999;107:468–478.** ©1999 by Excerpta Medica, Inc.

Dizziness is a common symptom that accounted for more than 5.6 million clinic visits in the United States in 1989 (1). Surveys suggest that 15% to 30% of patients, most often women and the elderly, will experience dizziness severe enough to seek medical attention at some time in their lives (2–10).

Dizzy patients are generally classified by either symptoms or etiology. Drachman and Hart (11) proposed a "complaint-oriented" approach, classifying dizziness as vertigo (rotational sensation), presyncope (impending faint), disequilibrium (loss of balance without head sensation caused by visual impairment, peripheral neuropathy, vestibulopathy, central nervous system disease, and musculoskeletal or locomotor disturbances), or lightheadedness (ill-defined, not otherwise classifiable). Although vertigo usually suggests a vestibular disorder, dizziness is generally a nonspecific symptom that can occur with many disorders, including vestibular, cardiovascular, neurologic, metabolic, and psychiatric diseases. Many patients have more than one cause of dizziness, especially if symptoms persist longer than several weeks (12). Consequently, there is no simple algorithm for evaluating dizzy patients, and clinicians must be guided by the history and physical examination.

Most patients complaining of dizziness have peripheral vestibulopathies (benign positional vertigo, Meniere's disease, vestibular neuronitis, labyrinthitis) or psychiatric disorders, although elderly patients are more likely to have central vestibular disorders (cerebrovascular disease, tumor) (11–22). Clinicians are often uncertain about whether to refer dizzy patients for further diagnostic studies, particularly vestibular function tests and cardiovascular and neurologic testing. Despite the publication of several reviews of dizziness (23–27), there are no evidence-based guidelines for evaluating patients with dizziness. We conducted a structured literature synthesis focusing on the frequency of serious causes of dizziness, the prognosis for dizzy patients, the initial evaluation of dizziness, and the accuracy and utility of specialized diagnostic testing. We did not review the management of dizziness.

MATERIALS AND METHODS

We searched the MEDLINE database to identify articles on the epidemiology and diagnostic evaluation of dizziness using the MeSH headings dizziness and vertigo and the subheadings epidemiology, classification, diagnosis, and etiology. We also searched the MeSH headings ves-

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Supported by the Clinical Efficacy Assessment Project, American College of Physicians.

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Manuscript submitted December 1, 1998, and accepted in revised form June 24, 1999.

0002-9343/99/$–see front matter
PII S0002-9343(99)00260-0

tibular function tests, electronystagmography, and calorics, and the following text words: nystagmus, Barany, Hallpike, caloric testing, and brainstem auditory evoked responses. Studies were also identified from review articles and bibliographies of retrieved articles. Two investigators independently evaluated titles and abstracts to decide which articles to retrieve. To be included, studies had to be published in the English language between 1966 and 1996, and had to present original data on at least 10 dizzy or vertiginous patients 18 years of age or older. Diagnostic test results had to be compared with a reference (gold) standard or applied to a control group. Epidemiologic or diagnostic test data had to be reported or calculable.

Studies were independently abstracted by two investigators. Differences in data abstraction were resolved by consensus or arbitration by the third investigator.

RESULTS

The literature searching identified 1,755 references. The majority of these references were either reviews that contained no original data, case reports, articles focusing on the pathophysiology and treatment of dizziness, or technical reports on diagnostic tests. After reviewing titles and available abstracts, we retrieved 229 references. A further 100 references were identified from searching bibliographies, of which 44 were retrieved. The critical review was based on 12 etiology studies, 16 prognosis studies, and 38 studies evaluating diagnostic testing.

Etiology

Twelve studies (11–22) reported etiologic data in patients with a chief complaint of dizziness; only one study included any syncopal patients (21). There were two primary-care based studies, one of which (12) excluded patients whose symptoms resolved within 2 weeks of their initial clinic visit (12,20); 4 studies from emergency department patients (12,14,16,18,19); and 6 referral-based studies, including otolaryngology, neurology, and "dizziness" clinics (11,13,15,17,21,22). Four studies focused exclusively on older patients (13,17,21,22).

The most common causes for dizziness were vestibular disorders, psychiatric illnesses, presyncope, and disequilibrium (11). The peripheral vestibular disorders, which affect inner ear structures and the eighth cranial nerve, include benign positional vertigo, vestibular neuronitis, labyrinthitis, and Meniere's disease. Benign positional vertigo is characterized by brief episodes of intense vertigo associated with changing head position, and may be idiopathic or occur after viral infection or trauma (28). Vestibular neuronitis presents with severe vertigo associated with nausea and vomiting, and symptoms may persist for hours to days (29). When cochlear involvement (tinnitus, hearing loss) is detected, the term labyrinthitis is used to describe the peripheral disorder. Labyrinthitis usually follows a viral upper respiratory infection (30). Meniere's disease, an abnormal collection of endolymphatic fluid in the inner ear, is a syndrome of episodic vertigo lasting hours associated with neurosensory hearing loss, tinnitus, and ear fullness (31). Peripheral vestibulopathy also includes a heterogeneous group of disorders sometimes attributable to a specific cause (eg, ototoxic drugs, inner ear trauma, perilymphatic fistula) but more often characterized by idiopathic vertigo or dizziness associated with nystagmus or other vestibular findings.

Central vestibular disorders are diagnosed by vertical nystagmus or neurologic findings consistent with cerebrovascular disease (usually vertebrobasilar), tumors (especially acoustic neuromas that cause unilateral hearing loss and vertigo), and other central nervous system diseases, including multiple sclerosis and migraine. Presyncope is described as a sensation of impending loss of consciousness and can be related to cardiovascular disease, postural hypotension, and metabolic disorders. Psychiatric causes, such as anxiety and depression, usually manifest as lightheadedness and can be diagnosed with structured interviews and validated instruments. Patients with disequilibrium are unsteady when walking and do not feel dizzy when sitting or lying down. Most common in elderly patients, it results from a combination of sensory deficits, including visual impairment, neuropathy, vestibular disorders, and musculoskeletal disturbances (11).

Routine clinical examination used to evaluate dizzy patients in these studies included cardiovascular and neurologic examinations (Table 1). Laboratory tests included serum chemistry panels, complete blood counts, thyroid function tests, and serologic tests for syphilis. Few tests were performed in all patients because testing was based on the patient's clinical presentation.

In these studies, dizziness was often multifactorial (Table 2). In one primary care clinic, only 52% of 100 patients with dizziness had a single cause (12). A community-based study found multiple diagnoses in 126 (85%) of 149 elderly people complaining of dizziness (32), and multiple causes of dizziness were found in 49% of older men seen in a neurology clinic (21).

Between 10% and 25% of dizzy patients remained undiagnosed. Even comprehensive dizziness clinics failed to make a diagnosis for 9% to 22% of patients (11, 17, 22). Among diagnosed patients, peripheral vestibulopathy—benign positional vertigo, vestibular neuronitis, and Meniere's disease—accounted for about 50% of dizziness seen in primary care. Psychiatric disorders may play a causative or contributory role in 10% to 25% of patients, although only four studies (11,12,21,33) systematically evaluated dizzy subjects for psychiatric diagnoses. Other investigators (34–38) have also found a substantial prevalence of anxiety disorders, major depression, and soma-

Table 1. Characteristics of the 12 Studies of the Etiology of Dizziness

Clinical Setting, Year (Reference)	Study Design	Sample Size (n)	Mean Age (Years)	Women (%)	Symptom Duration	Diagnostic Testing
Dizziness clinic, 1972 (11)	Prospective	104	NA	NA	NA	Hallpike, orthostatic vital signs, hyperventilation Structured psychiatric evaluation Audiometry Electronystagmography ECG, Holter monitor EEG, NCV, ophthalmology Laboratory testing
Primary care clinic, 1992 (18)	Prospective	100	63	60	2 weeks	Hallpike, orthostatic vital signs, hyperventilation Structured psychiatric evaluation Audiometry ECG CNS imaging Laboratory testing
Neurology clinic, 1984 (13)	Prospective	100	55	0	NA	Hallpike, hyperventilation Audiometry Electronystagmography Holter monitor Brain stem auditory evoked responses Laboratory testing
Emergency department, 1985 (14)	Retrospective	121	57	53	NA (19% recurrent)	Hallpike, orthostatic vital signs ECG Laboratory testing
Dizziness clinic, 1986 (15)	Retrospective	2222	48	53	NA	Audiometry Electronystagmography
Emergency department, 1989 (16)	Prospective	125	47	58	NA	Hallpike, orthostatic vital signs, hyperventilation ECG Laboratory testing
Neurology clinic, 1989 (17)	Retrospective	116	76	55	Mean 36 months	Hallpike, orthostatic vital signs, Audiometry Electronystagmography ECG, Holter monitor, Doppler ultrasound of carotid arteries CNS imaging, EEG, Brain stem auditory evoked responses, cerebral angiography Laboratory testing
Emergency department, 1980 (12)	Retrospective	106	Range 7–88	65	NA	Hallpike, orthostatic vital signs Audiometry ECG Laboratory testing
Emergency department, 1994 (19)	Prospective	93	50	58	NA	Hallpike Audiometry Electronystagmography ECG CNS imaging Laboratory testing
Primary care clinic, 1994 (20)	Prospective	140	59	72	Age <60 years: 69% >3 mos Age ≥60 years: 48% >12 mos	Audiometry Electronystagmography ECG, Holter monitor, echocardiogram, Doppler ultrasound of carotid arteries CNS imaging Laboratory testing

Table 1. Continued

Clinical Setting, Year (Reference)	Study Design	Sample Size (n)	Mean Age (Years)	Women (%)	Symptom Duration	Diagnostic Testing
Neurology clinic, 1994 (21)	Prospective	117	70	0	Median 45 weeks	Hallpike, orthostatic vital signs, hyperventilation Structured psychiatric evaluation Audiometry Electronystagmography ECG, Holter monitor CNS imaging, EEG, brain stem auditory evoked responses, NCV Laboratory testing
Dizziness clinic, 1994 (22)	Retrospective	1194	74	63	NA	Hallpike Audiometry Electronystagmography CNS imaging Laboratory testing

* Laboratory testing includes measurement of serum electrolyte and glucose levels, complete blood counts, thyroid function tests, and serological tests for syphilis.
ECG = electrocardiogram; NA = not available; CNS = central nervous system; EEG = electroencephalography; NCV = nerve conduction velocities.

tization, although these studies were limited by small sample sizes and selection biases.

The frequency of presyncope as a cause for dizziness ranged from 2% in a dizziness clinic (15) to 16% in an emergency room (39). Most presyncopal patients had symptoms attributable to postural change (with or without orthostatic hypotension) rather than cardiac arrhythmias. Postural symptoms without orthostatic blood pressure changes are particularly common in the elderly. Colledge et al (32) found that 31% of an elderly community-based cohort became dizzy with postural change without a fall in blood pressure, and Ooi et al (40) found that nearly 20% of frail nursing home patients with dizziness or lightheadedness on standing did not have orthostatic blood pressure changes. Only six studies diagnosed disequilibrium, with a prevalence of 1% to 15% (11–13,16, 17,21).

Serious causes for dizziness, including cerebrovascular disease, tumors, other central nervous system disorders, and cardiovascular disease were infrequent. The most common central nervous system cause in primary care patients was cerebrovascular ischemia or infarction (median 5%, range 2% to 10%); tumors were found in <1% of dizzy patients. Tumor rates were higher (2% to 3%) in older patients referred to neurologists.

In the "other" category, prescription drug toxicity accounted for 2% to 10% of dizziness. Less common causes included substance abuse, metabolic abnormalities, hepatic encephalopathy, electrolyte disturbances, infections (systemic and upper respiratory), hypertension, trauma, anemia, Alzheimer's disease, Parkinson's disease, seizures, and endocrine disorders (14,16,18–22,41,42).

PROGNOSIS

Peripheral Vestibular Disorders

Five articles provided follow-up information on patients diagnosed with specific etiologies of dizziness, including two studies of vestibular neuronitis (43,44), one of benign positional vertigo (45), and two of Meniere's disease (46,47). In benign positional vertigo (45), symptoms persisted in 33% of patients examined >1 month after presentation. For patients with vestibular neuronitis, symptoms of dizziness generally resolved within 3 months to 1 year (43,44). In Meniere's disease, cochlear function fluctuated initially but then deteriorated until stabilizing at a hearing threshold of 50 dB with a speech discrimination capacity of 50% to 60%; the attacks of vertigo tended to decrease in intensity and frequency by 10 years of follow-up (46,47).

Although the prognosis of patients with peripheral vestibular disorders appeared favorable, the studies had important methodologic limitations. Investigators retrospectively studied referral patients—introducing selection bias—and did not assemble inception cohorts. Diagnoses often were not documented adequately for study inclusion; for example, two large studies (45,46) needed to exclude 68% to 89% of the patients with vestibular disorders. The follow-up period ranged from 1 month to greater than 10 years; follow-up data were unavailable for up to 53% of patients. Follow-up usually was by chart review and reexamination, tending to bias results toward an overall poorer prognosis because patients with less severe disease are more easily lost to follow-up. Outcomes other than symptoms (eg, mortality, stroke, inter-

Table 2. Etiologies of Dizziness (Percentage of Patients)*

	Peripheral Vestibulopathies				Central Vestibulopathies					Presyncope				
Study	Benign Positional Vertigo	Vestibular Neuronitis	Meniere's Disease	Other†	Stroke or Transient Ischemic Attack	Tumor	Other‡	Psychiatric	Hyperventilation	Arrhythmia	Orthostatic/ Postural	Disequilibrium	Other§	Undiagnosed
Ref. 11	12	4	4	19	5	0	2	9	24	0	3	14	9	9
Ref. 18	4	7	0	0	10	0	0	15	2	5		0	53	5
Ref. 13	12	18	6	4	5	6	8	10	9	5	0	15	2	0
Ref. 14	7	11	0	7	2	0	0	5	0	0	0	0	33	37
Ref. 15	17	3	10	6	4	0	0	21	0	0	2	0	0	19
Ref. 16			54		6	0	0	6	5	3	13	1	32	10
Ref. 17	26	9	9	9	20	2	5	10	0	1	2	3	3	16
Ref. 12	16	3	4	30	0	0	0	26	1	10		10	0	8
Ref. 19	8	19	4	24	2	1	3	3	3	0	0	0	12	22
Ref. 20	7	23	0	2	6	1	0	11	1	0	10	0	35	0
Ref. 21	26	3	4	23	7	3	0	2	1	5	3	8	4	14
Ref. 22	44	4	5	11	8	1	1	8	0	0	0	0	15	25

* Total exceeds 100% for studies in which dizziness was attributed to multiple causes.

† Includes true vertigo of unknown cause.

‡ Includes multiple sclerosis, migraine, and cerebellar degenerative disease.

§ Includes drug toxicity, substance abuse, metabolic and endocrine abnormalities, electrolyte abnormalities, infections, hypertension, trauma, anemia, Alzheimer's disease, Parkinson's disease, and seizures.

ference with daily activities) were reported infrequently and there were no studies of the prognosis of patients with central vestibular disorders.

Dizziness as a General Complaint

Eleven studies (6,7,10,14,16,20,21,48–50) provided follow-up information on patients with dizziness. The one study that enrolled predominantly primary care patients (48) found that those with psychiatric disorders, disequilibrium, vestibulopathy other than benign positional vertigo or labyrinthitis, as well as those with daily symptoms, were more likely to have persistent dizziness. Patients with persistent dizziness had substantial impairment in health-related quality of life (49,51). Elderly patients with chronic dizziness had a greater degree of psychological distress than age-matched healthy controls (33), and were at increased risk for falling (10,50).

Results were difficult to interpret because multiple etiologies of dizziness were included in the study cohorts. Furthermore, follow-up periods ranged from only 3 to 24 months, no study began with the first episode of dizziness, patients often had chronic symptoms, and most were elderly. Dizziness did not appear to lead to severe disability, as measured by declines in activities of daily living (6) or nursing home placement (7). There was no evidence that dizzy patients were at increased risk of mortality (6,7,48).

CLINICAL EVALUATION OF DIZZINESS

History and Physical Examination

Only a few studies evaluated the diagnostic accuracy of specific items in the history and physical examination, although the office evaluation provided a probable diagnosis in about 75% of patients (11,14,17–19,21,32). Investigators attempted to classify dizziness into the categories of vertigo, presyncope, disequilibrium, and lightheadedness by directing the history toward the quality and duration of the dizziness, precipitating factors, and associated symptoms. Medical problems and medication use were also routinely determined.

Two studies found that 69% (17) to 76% (12) of diagnoses were based on the history alone. By comparison, physical examination contributed much less diagnostic information. Performing the Hallpike (Dix-Hallpike, Nylen-Barany) test to detect benign positional vertigo in vertiginous patients and measuring orthostatic changes in blood pressure and pulse in patients who became symptomatic on standing were the most helpful maneuvers.

The Hallpike test begins with the patient sitting upright, looking at the examiner's forehead (52). The examiner turns the patient's head 30° to one side and has the patient quickly lie down, hyperextending the neck so that the head hangs about 30° below the edge of the examining table. While the patient looks straight ahead for 10 to 15 seconds, the examiner observes for nystagmus. Nystagmus may not be induced if the maneuver is performed too slowly (>20 seconds) (53). The patient then sits up and the test is repeated with the head turned in the opposite direction. Patients are instructed to keep their eyes open, even if they feel dizzy. The nystagmus of peripheral vestibular disorders is rotatory with a horizontal or vertical component, begins after a latency of several seconds, lasts <30 seconds, and extinguishes with repeated testing (52). Nystagmus that is primarily vertical, develops immediately upon lying down, or persists despite repeated testing suggests a possible central vestibulopathy, although vertical nystagmus can occasionally occur with vestibular neuronitis (54).

The Hallpike maneuver was positive in 16% (median) of dizzy patients; the proportion of patients with positive tests ranged from 7% to 44%, reflecting the differences in clinical settings, patient characteristics, and duration of symptoms (11,12,16–18,21,22). In patients with benign positional vertigo, which has a fluctuating clinical course with gradual improvement, the sensitivity of the Hallpike maneuver ranged from 50% to 88% (45,55,56).

Orthostatic measurements require supine and standing blood pressures and pulse determinations; generally, standing pressures are obtained immediately and then after 2 to 3 minutes. A consensus guideline defined orthostatic hypotension as a reduction of systolic blood pressure of at least 20 mm Hg or diastolic blood pressure of at least 10 mm Hg (57). Although study investigators used different definitions for a positive test, most required at least a 20 mm Hg drop in systolic blood pressure or a 10 beat per minute increase in heart rate (11,12,16,21). Orthostatic changes were found in 5% (median) of dizzy patients, with a range from 2% to 8% (11,12,14–16,18, 21).

Laboratory Testing

Although frequently ordered, laboratory tests, including complete blood counts, serum electrolyte, glucose, and creatinine levels, thyroid function tests, and serologic tests for syphilis had a very low yield in identifying a specific cause for dizziness. Among the 4,538 patients included in the etiologic studies (11–22), laboratory abnormalities that explained the dizziness were limited to 3 patients with electrolyte disturbances, 11 with glucose disorders, 11 with anemia, and 1 with hypothyroidism.

Psychiatric Screening

Four studies that used structured psychiatric interviews found that multiple physical complaints and the clinician's assessment that a physical etiology was absent made psychiatric causes more likely (2,33,36,51). Among patients presenting to an otolaryngology clinic, those with a greater mean number of lifetime psychiatric disorders, particularly major depression and panic attacks,

were less likely to have a peripheral vestibular disorder (35, 36). The cross-sectional design of many studies and the lack of trials of psychiatric treatment prevents definitive conclusions about a causal relation with dizziness. Nonetheless, recognizing a coexistent depressive or anxiety disorder in a dizzy patient is important, because such disorders may be treated effectively.

REFERRAL AND SPECIALIZED TESTING

Certain findings from the history or physical examination of the dizzy patient should prompt consideration of further diagnostic testing or referral to specialists. Patients presenting with central vestibular, cerebellar, or focal neurologic findings require further neurological testing. Those with orthostatic blood pressure changes, syncope, and other cardiovascular findings also need further evaluation (58–60).

Evaluating dizzy patients who do not have obvious psychiatric, otologic, cardiovascular, or neurologic problems is a challenge for primary care physicians. Several diagnostic tests can be ordered, including audiometry, vestibular function tests, cardiac monitoring, echocardiography, vascular studies, neuroimaging, electroencephalograms, and brain stem evoked responses.

Audiometry

Audiograms are routinely recommended for evaluating dizzy patients with hearing complaints (23–25). Fluctuating hearing loss is characteristic of Meniere's disease, and acoustic neuromas typically present with gradual hearing loss. Nonetheless, investigators have reported normal hearing in 6% of patients with Meniere's disease (61) and in 7% of patients with acoustic neuromas that are smaller than 1 cm in diameter (62). For acoustic neuromas between 1 cm and 3 cm, normal hearing was found in 3%; no patients with tumors greater than 3 cm had normal hearing.

Electronystagmography

Electronystagmography tests vestibular function by using electrodes to detect nystagmus that appears spontaneously or when induced by lateral gaze, positional change, or caloric testing. Thirteen studies provided data on the diagnostic accuracy of electronystagmography for dizziness and vertigo, 8 of which (17,39,63–68) included data on the test's sensitivity for the detection of peripheral and central vestibular disorders; the remaining studies presented only data on test specificity (69–73).

Two studies (39,63) provided enough data to estimate both sensitivity and specificity. In a series (39) of 93 consecutive patients with acute dizziness in an emergency room setting, electronystagmography (without caloric testing) had good sensitivity and specificity for central and peripheral disorders. Using clinical examination and central nervous system imaging as the reference standard, the investigators reported a sensitivity of 74% and a specificity of 83% for peripheral vestibular disorders. For central vestibular disorders, the sensitivity was 81% and the specificity was 93%.

A second study (63) used audiograms, lumbar puncture, electroencephalography, and central nervous system imaging as reference standards to evaluate 127 patients (mainly with chronic dizziness) who were referred to neurology and otolaryngology clinics. The overall sensitivity of electronystagmography for vestibular disorders was only 46%, with a specificity of 81%. Sixty-nine subjects were diagnosed with central vestibular disorders, but electronystagmography was abnormal in only 28 (sensitivity of 42%); 9 of the 13 patients (sensitivity of 69%) with peripheral vestibular disorders had abnormal studies. The investigators noted that electronystagmographic findings had limited localizing value and that additional studies were usually needed to make a definitive diagnosis.

The other studies that provided sensitivity data included only patients with documented vestibular disorders (17,64–68). Most were seen in referral clinics, often weeks after developing symptoms. The sensitivity of electronystagmography for diagnosing peripheral vestibular disorders was poor in these patients, ranging from 29% to 56% (17,64–66,68). Sensitivity for detecting central vestibular disorders varied widely, from 26% to 95% (17,64,67). It was not possible to determine whether the type of brain lesion affected test sensitivity.

Electronystagmography has limited specificity. In one study of asymptomatic volunteers aged 11 to 70 years, more than 50% had spontaneous or positional nystagmus and the rate approached 80% in those older than 50 years of age (69). Among asymptomatic persons, 4% to 25% (69–71) had spontaneous nystagmus, and 5% to 28% had abnormal positional nystagmus (69,71,73). In a community-based study, Colledge et al (32) found that 80% of elderly patients with dizziness and 79% of elderly controls had at least two electronystagmographic abnormalities. Electronystagmography did not consistently distinguish central from peripheral disorders. Pathologic findings suggestive of central causes of vertigo (vertical and nonfatigable nystagmus) were found in 10% to 13% of patients who were diagnosed with peripheral vestibular disorders (72, 74).

Cardiovascular Testing

Cardiovascular tests include electrocardiography, ambulatory electrocardiography, echocardiography, and carotid Doppler examinations. Two studies—one in a primary care clinic (12) and another in an emergency department (14)—did not find any diagnostic electrocardiographic changes in dizzy patients. In a neurology clinic (21), 5% of dizziness was attributed to arrhythmias.

However, the patients were older men and 12% of them reported syncopal episodes. In an emergency department series (16), critical electrocardiographic findings (ischemia, paroxysmal supraventricular tachycardia) were seen in 6 of 125 patients, 5 of whom had known coronary disease or arrhythmias. A Swedish study reported only four explanatory findings in 32 patients with repeated episodes of dizziness referred for ambulatory electrocardiographic monitoring (75). None of the patients had syncope. The abnormalities included paroxysmal atrial fibrillation, sinus arrest, and third-degree heart block. Colledge et al (32) found normal 24-hour ambulatory electrocardiography in 70% of elderly patients with dizziness, although about one half of them were symptomatic during the recording. The most common abnormality was asymptomatic paroxysmal atrial fibrillation. A retrospective study of 129 consecutive dizzy male veterans seen in a neurology clinic and referred for echocardiography concluded that testing was not helpful. The few unexpected valvular abnormalities were not considered clinically important; and none of the patients had any medication changes, underwent angiography, or had cardiac surgery within the next 3 months (76).

A university-hospital study of noninvasive carotid artery testing identified hemodynamically significant disease in 21 of 101 consecutive elderly patients referred for dizziness, including some patients with syncope, focal neurologic findings, and symptoms of vertebrobasilar insufficiency (77). Doppler studies were normal in the 7 patients who complained of isolated vertigo.

The studies evaluating cardiovascular diseases had methodologic limitations because they used referral-based populations, test interpretations were not blinded, and the only data reported were the proportions of patients with abnormal tests.

Neurologic Testing

Neurologic tests for dizziness include central nervous system imaging, electroencephalography, and brain stem auditory evoked responses. Ojala et al (78) reported on the use of central nervous system imaging for evaluating dizziness. They found a high yield (34%) of abnormalities that had probable clinical relevance, but all patients had been referred for clinical suspicion of a central nervous system process. Another study (79) reported a high rate of abnormalities (33%) with magnetic resonance imaging of the inner ear and cerebellopontine angle in 167 patients with vertigo, abnormal vestibular tests (often with sensorineural hearing loss), or both. Vertebrobasilar ischemic disease was diagnosed in 12 patients, and investigators also diagnosed 9 Schwannomas and one meningioma. A community-based study of 149 dizzy and 97 asymptomatic elderly subjects found that magnetic resonance imaging failed to distinguish the two groups because abnormalities were common in both groups (32).

Electroencephalography was evaluated in several studies. Hughes and Drachman (80) detected no seizure disorders among 97 patients in a dizziness clinic. Ojala et al (81) found that one third of 134 randomly selected patients referred to a dizziness clinic had electroencephalographic abnormalities, but seizure disorders (temporal lobe epilepsy) were diagnosed in only 3 patients, all of whom were already suspected of having seizures.

Few studies addressed the use of brain stem auditory evoked responses in evaluating dizziness or vertigo, and only one provided data on sensitivity and specificity. Ojala et al (81) found abnormal responses in 20 of 60 patients with central disorders, a sensitivity of 33%. The disorders included 3 patients with multiple sclerosis, 5 with vertebrobasilar ischemia, and 1 with meningomyelocele; 12 patients were described as having an uncertain etiology with "other evidence of a [central nervous system] lesion." The evoked responses were abnormal in only 1 of 50 patients with noncentral disorders (vestibular and psychogenic), a specificity of 98%. The validity and generalizability of these results are limited, however, because associated symptoms were not described, 80% of the patients were referred to tertiary care specialty clinics, and most of the central disorders remained undiagnosed and were not clearly related to the dizziness.

SUMMARY

Dizziness is a common, diagnostically challenging complaint that usually has a favorable prognosis. About 50% of dizzy patients have vertigo, usually due to peripheral rather than central vestibular disorders. Psychiatric disorders, particularly depression, anxiety, and somatization, may account for 10% to 25% of dizziness. An etiology cannot be established in another 10% to 25% of dizzy patients, even after a comprehensive evaluation. Serious causes, such as cardiac arrhythmias, brain tumors, and strokes, are rare, although more common in older patients. Although the literature on prognosis is methodologically flawed, dizziness does not seem to be associated with increased mortality or disability, even in the elderly. However, persistent dizziness can result in considerable patient distress and functional impairment (49,51).

The history and physical examination can lead to a diagnosis in about 75% of patients. Performing the Hallpike maneuver and measuring orthostatic blood pressure and pulse changes are useful. While abnormalities on the cardiovascular or neurologic examinations have important implications for subsequent testing and prognosis, the diagnostic yield is low. Routine laboratory testing rarely leads to unsuspected diagnoses, but screening by the primary provider for depression and anxiety using simple questionnaires (82,83) or even a few questions (84) may be useful, particularly for patients whose

symptoms cannot be attributed to another etiology, as well as for those with persistent or unexplained dizziness.

The usefulness of more complex diagnostic tests is uncertain. Electronystagmography, a widely ordered test, has reasonable sensitivity for vestibular disorders but does not accurately discriminate between central and peripheral vestibulopathies. The indications for ordering electronystagmography are uncertain. There are no data on the utility of vestibular function testing, such as whether and how often it leads to unsuspected diagnoses of vestibular disorders, changes in management, or better clinical outcomes (85). Results of electronystagmography in patients with vertigo usually only confirm the clinical diagnosis (12,42,51). The utility of electronystagmography in dizzy patients without vertigo or nystagmus is not known. A recent position paper (86) from the American Academy of Neurology concluded that the evidence supporting electronystagmography was "class III"—provided only by expert opinion, nonrandomized historical controls, or case reports.

Tests such as ambulatory electrocardiographic monitoring, echocardiography, vascular studies, central nervous system imaging, electroencephalography, and brain stem auditory evoked responses have a poor diagnostic yield in the absence of signs and symptoms pointing to cardiovascular or neurologic disease. Although older patients have a greater prevalence of cerebrovascular disease, cardiac disease, and tumors, the literature does not support routine specialized testing in these patients.

Our findings about which tests are warranted and which patients should be referred to otologic or neurologic specialists are inconclusive. Substantial methodologic limitations of existing studies precluded the development of strong evidence-based guidelines. The absence of rigorous prospective studies of large numbers of dizzy patients may be insufficient justification for changing what some experts consider to be the standard of care. Nonetheless, the very low prevalence of serious disorders should be considered when determining whether to order tests in dizzy patients.

Issues to address in future research include determining the sensitivity and specificity of vestibular testing. Investigators should clarify which tests should be included in a basic battery, and which should be used only in selected patients. Although there is no objective gold standard for most types of dizziness, investigators should prospectively define a reference standard that is not based on the test under study, use appropriate blinding, and include a spectrum of patients with central vestibulopathy, peripheral vestibulopathy, and nonvestibular causes of dizziness as well as control patients. Another important issue is determining the therapeutic effect of abnormal vestibular testing and whether its use improves patient outcomes. Finally, practice guidelines for the primary care evaluation and management of dizziness, including indications for subspecialty referral or testing, should be developed and validated.

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