How Often is Dizziness from Primary Cardiovascular Disease True Vertigo? A Systematic Review

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OBJECTIVES: To assess how frequently cardiovascular dizziness is vertigo. Recent studies suggest providers do not consider cardiovascular causes when a patient reports true vertigo (spinning/motion) as opposed to presyncope (impending faint). It is known that cardiovascular disease causes dizziness, but unknown how often such dizziness is vertiginous, as opposed to presyncopal.

DATA SOURCES: Systematic review of observational studies was made: *Search*—electronic (MEDLINE, EMBASE) and manual (references of eligible articles) search for English-language studies (1972–2007).

REVIEW METHODS: *Inclusions* Studies of ≥ 5 patients with confirmed cardiovascular causes for dizziness and reporting a proportion with vertigo were included. Two independent reviewers selected studies for inclusion, with differences adjudicated by a third. Study characteristics and dizziness-type proportions were abstracted. Studies were rated on methodology and quality of dizziness definitions. Differences were resolved by consensus.

RESULTS: We identified 1,506 citations, examined 125 full manuscripts, and included 5 studies. Principal reasons for exclusion were: *abstracts*—lack of original data, no cardiovascular diagnosis, or confounding exposure/disease (74%); *manuscripts*—failure to distinguish vertigo from other dizziness types (78%). In the three studies not using vertigo as an entry criterion (representing 1,659 patients with myocardial infarction, orthostatic hypotension, or syncope), vertigo was present in 63% (95% CI 57–69%) of cardiovascular patients with dizziness and the only dizziness type in 37% (95% CI 31–43%). Limitations include modest study quality and non-uniform definitions for vertigo.

CONCLUSIONS: Published data suggest that dizziness from primary cardiovascular disease may often be vertigo. Future research should assess prospectively whether dizziness type is a meaningful predictor for or against a cardiovascular diagnosis.

KEY WORDS: cardiovascular diseases; vertigo; syncope; medical history taking; diagnosis; meta-analysis.

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INTRODUCTION

Clinical Case Question. A 55-year-old woman presents to her physician's office with several spontaneous episodes of dizziness lasting up to 2 min over the past several months. On further questioning, her experience of dizziness is that of the world spinning. She has no other symptoms during these spells. Given her complaint of *spinning vertigo*, should non-cerebrovascular, cardiovascular causes (e.g., cardiac arrhythmia) be a diagnostic consideration?

Dizziness is a complex neurologic symptom reflecting a perturbation of normal balance perception and spatial orientation. It is commonly encountered across medical settings^{1,2} and in the general population³. The traditional approach to diagnosis relies heavily on the premise that dizziness type predicts the underlying etiology⁴. This “quality-of-symptoms” approach suggests that dizziness should be classified as one of four types based on the nature (quality) of dizziness: (1) *vertigo* (spinning or motion), (2) *presyncope* (impending faint), (3) *disequilibrium* (unsteadiness when walking), or (4) *non-specific dizziness* (any other dizziness sensation)⁵. Symptom quality then directs subsequent diagnostic inquiry, with vertigo prompting a search for vestibular causes, presyncope a search for cardiovascular causes, disequilibrium a search for neurologic causes, and non-specific dizziness a search for psychiatric or metabolic ones⁴. This represents the standard approach described in commonly used medical texts⁶ and published medical literature³. It is also the standard of clinical practice in frontline care settings^{7,8}.

The quality-of-symptoms approach was originally intended to be the beginning, rather than the end, of the diagnostic workup. However, out of necessity, frontline providers practicing in busy clinical settings frequently limit their approach based on this initial classification. For example, as stated in a recent academic review for emergency physicians, “The sensation of motion [*vertigo*] effectively removes the differential diagnosis from the cardiovascular into the realm of a specific neurological disturbance”⁹. It is common practice for emer-

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gency physicians to use this simple bedside rule to direct diagnostic inquiry—that is, most do not pursue cardiovascular causes when a patient reports vertigo⁸.

Single cases of well-characterized vertiginous presentations of dangerous cardiovascular disorders have been reported^{10,11}. Therefore, the rule that “vertigo excludes cardiovascular disease” cannot be accurate in an absolute sense. However, it remains unclear whether these cases are merely exceptions that prove the rule or indicators that the rule is invalid.

To help answer this question, we sought to determine the proportion of cardiovascular dizziness described as true vertigo (as opposed to presyncope or other dizziness), using a systematic review of observational studies in well-defined cardiovascular populations. We hypothesized that vertigo among patients with cardiovascular dizziness is not rare.

METHODS

Data Search

The search strategy was designed by a PhD-trained clinical investigator with relevant domain expertise (DNT) and the co-director of our Evidence-Based Practice Center with extensive experience in systematic reviews (KAR). We searched MEDLINE and EMBASE for English-language articles, using text words and controlled vocabulary terms including: *dizziness* and *vertigo*; *angina*, *arrhythmia*, and other terms related to cardiovascular disease (Appendix 1). We limited our search to articles published since 1972, the initial publication date of the four-type, quality-of-symptoms approach to diagnosing dizziness¹². We did not restrict our search by age. Our search was updated through to May 23, 2007. We also performed a manual search of reference lists from eligible articles and attempted to contact corresponding authors where appropriate. We did not seek to identify research abstracts from meeting proceedings or unpublished studies.

Data Selection

All gathered literature was subject to title and abstract screening by two independent reviewers. Articles were selected using pre-determined criteria. These criteria (Appendix 2) *excluded* papers that lacked original patient data; did not focus on confirmed diagnoses of cardiovascular ailments; involved confounding exposures (drugs or disease) that might have been responsible for dizziness/vertigo; failed to distinguish vertigo from other types of dizziness; or involved fewer than five subjects. We excluded studies with small numbers of subjects because we were interested in estimating the prevalence of vertigo and other types of dizziness in well-defined cardiovascular populations with dizziness, rather than noting its rare occurrence. We defined “cardiovascular” to include disorders that might cause dizziness through a global hypotensive mechanism; this included both primary cardiac diseases (e.g., myocardial infarction, arrhythmia) and disorders of the vascular tree (e.g., orthostatic hypotension, neurocardiogenic syncope). We chose not to search for hypertensive cardiovascular disorders, since these are known to be associated with direct nervous system effects such as hypertensive encephalopathy and intracerebral hemorrhage that might confound the association between cardiovascular disease and

symptomatic vertigo. Although some consider stroke and transient ischemic attack to be “cardiovascular” diseases¹³, we excluded such disorders for the same reason. We did not establish preconditions on the type or quality of the clinical studies to be included, nor did we apply an independent standard for confirmed cardiovascular causes identified by authors of the primary studies. We chose this approach because we suspected from the outset that studies available to address our research hypothesis were few in number and of limited quality.

Full-text screening was applied to all abstracts considered eligible or possibly eligible by at least one reviewer (i.e., labeled “yes” or “maybe” in the abstract review). Two independent reviewers identified whether full-text manuscripts were eligible and provided a reason for exclusion. A third reviewer verified the eligibility of selected articles and settled any discrepancies in selection status and reasons for exclusion.

Validity Assessment

Two unmasked raters and a third adjudicator assessed the methodological quality of included studies according to standard *levels of evidence* criteria for symptom prevalence studies¹⁴. Three raters graded the quality of definitions used for vertigo and other types of dizziness, relative to standard definitions, as described below.

We rated the quality of definitions *high* if the definitions for each type of dizziness reported on were clearly stated in the study and matched accepted definitions, *intermediate* if definitions were incomplete or deviated somewhat from standards, and *low* if definitions deviated substantially from standards or were not provided. True vertigo was defined according to accepted criteria¹⁵ as a sensation of spinning, rotation, or motion when no motion was occurring relative to the earth's gravity. Presyncope (near syncope) was defined as a sense of impending faint, without actual faint. Syncope was defined as brief loss of consciousness not attributable to seizure. Other dizziness was defined as a sense of dizziness other than vertigo or presyncope (including disequilibrium and non-specific dizziness). Lightheadedness was considered presyncope if the term was defined that way or used interchangeably in a manuscript with presyncope or near syncope (as has become customary for many physicians⁸) and otherwise classified with non-specific dizziness, according to the original four-type criteria¹².

Data Extraction

Data extraction was performed independently by two unmasked authors, and differences were resolved by consensus review that included input from two additional authors. Information abstracted from each article included study type, number of cardiovascular subjects, cardiovascular condition (s), explicit definitions for dizziness, prevalence of dizziness in cardiovascular cases, and proportion with vertigo or other types of dizziness.

Data Synthesis

We report the total proportion of cardiovascular dizzy patients across studies experiencing *any* vertigo (i.e., vertigo with or without other dizziness types) or *only* vertigo (i.e., vertigo

without other dizziness types). We restricted our final analysis of the combined total proportions to eligible studies that did not select on vertigo as an entry criterion. Where primary data from studies are incomplete (e.g., frequency of “vertigo” and “faintness,” but no numerical description of the overlap between these symptoms), we summarize using ranges from maximum possible overlap to minimum possible overlap. We present median values (half way between maximum and minimum) where necessary for subsequent calculations. We calculate proportions with 95% confidence intervals (95% CI). No formal tests of heterogeneity or subgroup analyses were performed. Data were handled in Reference Manager v11 (Stamford, CT), ProCite v5.0.3 (Stamford, CT), and Microsoft Excel 2003 (Redmond, WA). Confidence intervals and kappa values were calculated using Stata v6.0 (College Station, TX).

RESULTS

Search Results

Our search identified 1,506 unique citations, of which 1,380 were excluded at the abstract level. We did not demand concordance on reason for abstract exclusion, but, among concordant codings (85%, $n=1,178$), exclusions were as follows: 44% lacked original patient data; 22% did not focus on a cardiovascular population; 18% involved confounding exposures (15% treatment drugs, 3% co-morbid conditions) that might have caused dizziness/vertigo; 15% did not indicate any symptom data about dizziness had been recorded; 1% had no confirmed cardiovascular diagnosis; 0.4% were excluded for fewer than 5 subjects studied.

We sought to examine 126 full manuscripts, one of which was unretrievable. After initial screening, there were three disagreements about study inclusion (kappa 0.79) and seven on reason for exclusion when the two raters agreed on exclusion (kappa 0.85). These were settled by adjudication and discussion with the third reviewer. After full-text review, 120 articles were excluded, and 5 were eligible (Fig. 1). Eligible studies represented 0.3% of the total ($n=1,506$) and 1.3% of cardiovascular studies without confounding exposures ($n=373$). The principal reason for exclusion was failure to distinguish vertigo from other dizziness types (79%, $n=95$), but other exclusions were as follows: no confirmed cardiovascular diagnosis (6%, $n=7$); no original data (5%, $n=6$); not a cardiovascular study (4%, $n=5$); confounding exposure (3%, $n=3$); fewer than 5 subjects (1%, $n=1$); or other reasons (3%, $n=3$, all non-English language manuscripts despite English abstract).

All included studies were of modest quality either methodologically or in terms of dizziness definitions (Table 1). Two focused on vertigo with head-up tilt-table testing in patients with orthostatic dizziness or related symptoms (Grubb et al.¹⁹, Pappas²⁰). The other three catalogued symptom data from patients diagnosed with acute myocardial infarction (Culic et al.¹⁶), carotid sinus syndrome (Davies et al.¹⁸), and orthostatic hypotension (Low et al.¹⁷).

Findings

Although not the principal focus of our study, we can estimate the overall prevalence of dizziness in cardiovascular disease

(~10%) from the report by Culic et al. This was the largest ($n=1,546$) and most methodologically rigorous (level 1b evidence) of the five studies and the only one that did not select on dizziness, vertigo, or syncope as an entry criterion.

Among cardiovascular dizzy patients, the precise prevalence and proportion of vertigo, presyncope, and other dizziness is difficult to confidently assign (Tables 2 and 3). Two of the studies selected on vertigo as an entry criterion (Grubb et al., Pappas), so they should not be used for this calculation. None of the remaining studies (Culic et al., Davies et al., Low et al.) reported on the relative frequency of all four dizziness categories (vertigo, presyncope, disequilibrium, other), and two (Culic et al., Low et al.) did not include a breakdown of symptom overlap. This means we can only assign a *range* to the total number of dizzy patients and a *range* of relative proportions for the different dizziness types. However, from these data, we can still calculate median approximations and associated 95% confidence intervals for the proportion experiencing *any* vertigo (63%, 95% CI 57–69%) or *only* vertigo (37%, 95% CI 31–43%) (Table 3).

DISCUSSION

Our data show that there has been little systematic assessment of dizziness types among patients with primary cardiovascular disorders, and among those who do experience dizziness, vertigo appears to be frequent, rather than rare (~63%, including ~37% where vertigo was the *only* dizziness type reported). These findings question current clinical practice in the assessment of patients with dizziness. Specifically, using the presence of vertigo to exclude cardiovascular disorders from differential diagnostic consideration is not an evidence-based practice.

Among over 1,500 studies captured by our search, we found only 5 with data on the frequency of vertigo in cardiovascular disease. Contrary to conventional wisdom, none supported the contention that vertigo was rare among patients with dizziness of cardiovascular cause. From the most rigorously designed of these studies, we estimated that 10% of patients with primary cardiovascular disease may experience dizziness as a dominant or presenting symptom¹⁶. This estimate, based on patients with acute myocardial infarction, is probably a lower bound for the prevalence of symptomatic dizziness in cardiovascular diseases causing hypotension, given that 55–71% of syncope patients describe some form of dizziness just prior to their faint^{21,22}.

It is perhaps surprising that there are so few studies on this subject, when dizziness is the third most common major medical complaint seen in primary care¹ and affects more than 20% of the general population³. In part, the absence of data reflects the general dearth of symptom-oriented research studies²³. However, with dizziness, the entrenched quality-of-symptoms diagnostic approach (“vertigo is vestibular” and “presyncope is cardiovascular”) may have contributed to the lack of scientific inquiry⁵. There has been an artificial segregation of dizziness from syncope research³ with neuro-otology research (focused on vertigo and vestibular causes) and cardiology research (focused on syncope and primary cardiovascular disease) each conducted largely in isolation⁵. Major syncope studies have expressly excluded patients with dizziness or vertigo^{24–26}. As a result, there have been no compre-

Fig. 1. Citation search and selection. ¹ MEDLINE was accessed via PubMed; EMBASE—the Excerpta Medica database, ² abstracts coded as “yes” or “maybe” by at least one reviewer, ³ adjudication conducted by discussion with third reviewer.

hensive clinical or epidemiologic studies of dizziness in unselected patients^{3,27}.

Given the empiric association between cardiovascular disease and vertigo shown here, it is reasonable to question whether there is a biologically plausible pathomechanism. It is known that vertigo often results from physiologic imbalance (usually right versus left) in the vestibular system²⁸. It is conceivable that vertigo might also be a symptom of disturbed spatial perception⁵, even in the absence of frank right-left vestibular asymmetry; hence, global cerebral hypoperfusion (in association with systemic hypotension) might be sufficient explanation. Alternatively, we might postulate that global reductions in blood pressure lead to local asymmetries in blood flow to the vestibular system (because of congenital or acquired left-right asymmetries in vascular caliber), thereby causing vertigo via a transient-ischemic-attack-type mechanism, as has been suggested previously¹¹. Finally, we might theorize that parts of the vestibular system are differentially susceptible to global drops in pressure²⁹—either as a result of normal differences in collateral vascular supply to different parts of the vestibular end organ³⁰ or differential neuronal susceptibility to ischemia, as has been shown for subpopulations of cochlear hair cells³¹. Thus, there is no cause to dismiss the empiric findings of our review on theoretical grounds of biologic implausibility.

From a clinical standpoint, our findings indicate that the presence of vertigo should not obviate the need to search for a cardiovascular cause. However, we do not suggest that every vertiginous patient should undergo a complete workup for all

possible cardiac disorders. For instance, it is hard to imagine that patients with acute vestibular syndrome (continuous vertigo, nausea, vomiting, nystagmus, gait unsteadiness, and head motion intolerance, lasting days to weeks), as seen with vestibular neuritis or labyrinthitis, could have an underlying cardiac etiology. Here, the combination of symptom timing (continuous, lasting days or longer), triggers (exacerbation by head motion), and associated symptoms and signs (nystagmus, gait unsteadiness) presumably obviate the need to search for cardiac pathology. However, in patients with brief or intermittent dizziness that is either untriggered or brought on by exertion, caution should be exercised before dismissing a dangerous cardiac cause, even in the absence of chest pain, dyspnea, or other frankly cardiac symptoms¹¹.

Limitations

We identified several potential limitations to our conclusions. Perhaps we missed evidence related to dizziness in cardiovascular disease. However, we searched multiple sources, including completing hand searching of eligible articles. Even among original studies focused on confirmed cardiovascular disorders without confounding exposures, the proportion of articles reporting symptom data differentiating vertigo from other dizziness was very low (1.3%), so it is unlikely many relevant reports were missed. Although we limited our search to English-language literature, the quality-of-symptoms approach to dizziness diagnosis cannot be easily extrapolated to other languages or cultures, some of which use dizziness

Table 1. Study Design and Quality Ratings of Reports Identifying Frequency of Vertigo in Cardiovascular Disorders, Listed in Order of Descending Methodological Quality*

CV population (citation)	Clinical setting	Study method (data collection)	CV/total subjects (n/n)	Age; sex (mean (SD); female n)	Study quality; quality of dizziness definitions
Acute myocardial infarction [Culic, 2001 ¹⁶ †]	Hospital coronary care unit	Disease cohort [prospective]	1,546/1,546	N/D; N/D	Level 1b; low
Orthostatic hypotension [Low, 1995 ¹⁷ ‡]	Autonomic reflex laboratory referral	Symptom cohort [prospective]	90/155	64 [12]; 48	Level 3b; intermediate
Carotid sinus syncope [Davies, 1979 ¹⁸ §]	Cardiology referral	Case control [N/D]	23/75 (including 52 inpatient controls)	64 [10]; N/D	Level 4; low
Neurocardiogenic syncope [Grubb, 1992 ¹⁹ ¶]	Otolaryngology referral	Case control [N/D]	15/32 (including 11 normal controls)	52 [15]; 7	Level 4; intermediate
Orthostatic intolerance [Pappas, 2003 ²⁰ ¶]	Otology, neuro-otology referral center	Case series [retrospective]	33/113	~40 [11]; ~30#	Level 4; intermediate

CV—cardiovascular; N/D—not determined

*Study quality defined based on level of evidence for differential diagnosis/symptom prevalence study¹⁴. Although both represent “level 4” evidence, case control studies were ranked higher than case series studies, and those with larger sample size were ranked higher

†Large, prospective disease cohort with systematic symptom data collection on consecutive coronary care unit admissions for acute myocardial infarction over 4 years to compare symptom presentations based on myocardial infarction location; dizziness not a specific study focus

‡Consecutive referrals for orthostatic intolerance to autonomic laboratory; all complete symptom questionnaire; 90/155 diagnosed with orthostatic hypotension, 50% of these patients with pure autonomic failure or autonomic neuropathy as the cause. Although this was a prospective cohort study (generally considered level 1b evidence), the source population was fairly limited. Only patients referred for autonomic testing with a complaint of suspected orthostatic hypotension or equivalent were included, and the analysis focused only on those with orthostatic hypotension as a defined cause. Because of the potential for referral bias, this study cannot be assumed to offer a wholly unbiased estimate of relative symptom prevalence of the different dizziness types

§Consecutive patients with syncope, near syncope, or transient amnesia with positive carotid sinus massage; source and derivation of study population poorly described

¶Patients with recurrent vertigo associated with recent syncope or near-syncope and unknown etiology after neuro-otologic testing; 15/21 patients with positive tilt and response to therapy for neurocardiogenic syncope; 4/21 patients with structural heart disease. “This study evaluated the clinical use of head-upright tilt-table testing in the evaluation of recurrent vertigo, near-syncope, and syncope of unknown origin in patients referred for otolaryngologic evaluation.” No mention was made of the specific setting in which tilt-table testing was conducted, and there was no further description of the derivation of the source population

¶Patients with recurrent vertigo (but no vestibular disorder) associated with orthostatic intolerance and found to have autonomic symptoms and abnormal autonomic function tests; symptoms reproduced by head-up tilt-table test in 33. Testing protocols appear to have been selectively applied or reported

#Demographic values reported for the larger population, but not specifically for the 33 with confirmed orthostatic intolerance reproduced by head-up tilt-table test

terms very differently (e.g., to describe a general feeling of malaise or sickness³²). Still, it remains possible that publication bias would have favored reports of vertiginous dizziness in cardiovascular disease, obscuring what could be “true” rarity of vertigo in cardiovascular disease. However, the largest, highest quality study on which we report (Culic et al.) was not focused on dizziness and had no specific hypothesis on this issue—yet it showed a higher prevalence of vertigo than presyncope.

Dizziness is generally a transient symptom, so the precise link between disease and symptoms is often difficult to establish conclusively. Patients with more than one illness (a cardiac one causing presyncope or syncope, and a non-cardiac one causing vertigo) might have their vertigo misattributed to the cardiac cause, if the non-cardiac diagnosis went undiagnosed. In the case of Culic et al., we are comforted that the disease process was acute, and the presenting manifestations were systematically recorded¹⁶. In Davies et al., the co-occurrence of vertigo and syncope in two of the cases make separate causes implausible¹⁸. In Low et al., the relationship between orthostatic hypotension and symptoms is supported by the clear report of “orthostatic vertigo”¹⁷. Finally, the two studies reporting on symptoms elicited during head-up tilt (Grubb et al., Pappas) provide strong support for the immediate relationship among vertigo, syncope, and a primary cardiovascular cause, since the tilt test itself is cardiovascular in nature (once primary vestibular causes have been excluded, as was done in these studies).

Ideally, the studies would have provided a uniform definition for vertigo and the other types of dizziness, all aligned with

standard definitions. However, demanding high-quality definitions would have resulted in our including no studies in this review. We chose to present the available evidence, allowing our readers to assess its relative strength or weakness. Two studies (Culic et al., Davies et al.) did not provide an explicit definition of vertigo. In these studies, the definition of the various dizziness terms was inferred from the authors’ choice of categories (e.g., vertigo versus lightheadedness versus syncope for Davies). We were particularly interested in ascertaining the definition of vertigo used by Culic et al., since this study had the largest ‘n’ and the most rigorous design, but were unable to reach the corresponding author for clarification. Our comfort including this study in the review was enhanced by the mention of associated tinnitus (clustered with vertigo) in patients with anterior myocardial infarction, suggesting otologic manifestations of the primary cardiovascular disorder¹⁶. Despite the apparent heterogeneity in the definitions of vertigo, the findings are bolstered by the relative homogeneity of the results—none of the studies suggested vertigo was a rare manifestation. In the one study that offered both a clear definition for “vertigo” and better than level 4 evidence (Low et al.), patients with orthostatic dizziness frequently experienced vertigo (~39%).

Taking the results at face value, some may still be concerned that we have brought the wrong type of evidence to bear on the question of interest. Properly, a question about diagnostic decision-making requires symptom-oriented data (e.g., likelihood ratio or predictive value) rather than disease-oriented data. We really want to know, “Given vertigo, what is the likelihood the

Table 2. Prevalence* of Vertigo and Other Dizziness Symptoms in Cardiovascular Disorders, Listed in Order of Methodological Quality

CV population (citation)	Dizziness types reported; definition of vertigo	CV subjects (n)	Vertigo (%)	Presyncope (%)	Other dizziness (%)
Acute myocardial infarction [Culic, 2001 ¹⁶ †]	"Vertigo" and "faintness," neither explicitly defined; <i>vertigo</i> : N/D	1546	8.0	5.3	N/D
Orthostatic hypotension [Low, 1995 ¹⁷ ‡]	"Lightheadedness (dizziness)" and "vertigo" as separate from "syncope," with vertigo explicitly defined; <i>vertigo</i> : "an impulse of falling and a sense of movement relative to the environment"	90	37	N/D	88
Carotid sinus syncope [Davies, 1979 ¹⁸ §]	"Light-headedness" (also called "near syncope") and "vertigo" as separate from "syncope," none explicitly defined; <i>vertigo</i> : N/D	23	17	8.7	N/D
Neurocardiogenic syncope [Grubb, 1992 ¹⁹]	"Vertigo" and "near syncope" as separate from "syncope," each explicitly defined; <i>vertigo</i> : "giddiness or an irregular whirling or turning sensation of motion"	15	93	33	N/D
Orthostatic intolerance [Pappas, 2003 ²⁰ ¶]	"Dizziness," "vertigo," and "presyncope," as separate from "syncope" with vertigo explicitly defined; <i>vertigo</i> : "a sensation of motion when no motion was occurring relative to the earth's gravity"	33	77 #	24 #	96 #

CV=cardiovascular; N/D=not determined

*Reported are prevalence estimates for each dizziness type in all confirmed cardiovascular patients with dizziness, except in Pappas, who reported only the proportion of patients with a given dizziness type whose symptoms were reproduced during autonomic testing. Note that, except in Culic et al., patients under study were selected for dizziness or vertigo, so the raw prevalence estimates do not generalize to unselected cardiovascular patients. Note also that different dizziness symptoms in several studies were documented as co-occurring (i.e., the same patient may have experienced more than one dizziness type), so percentages frequently add up to more than 100% of the reported study population

†Syncope not explicitly segregated from presyncope in "faintness" category

‡Orthostatic vertigo was a common, spontaneous complaint by the patient; lightheadedness and dizziness (together 88%) were coded under a single heading

§Two of four cases with vertigo were associated with syncope; one of two cases with near syncope was associated with syncope

|| A total of 67% (10/15) had syncope; 9 of 10 were preceded by vertigo; patients selected on vertigo entry criterion

¶Patients selected on vertigo entry criterion; testing protocols appear to have been selectively applied or reported

#In the Pappas study, data on symptoms were not presented for all 33 orthostatic intolerance patients as a single group. For vertigo (77%), n=17/22; for presyncope (24%), n=4/17; for other dizziness (96%), n=25/26

patient has cardiovascular disease?" We have substituted the question, "Given cardiovascular disease, what is the likelihood of vertigo?" Taking this approach is necessary here given the lack of studies available to answer the first question^{2,3,33}. This is a limitation in current scientific knowledge, and we await rigorous, prospective, symptom-oriented studies in unselected populations to properly answer this question.

Finally, it is possible that patients in the identified studies experienced co-morbid symptoms such as chest pain or

dyspnea. These might have made the cardiovascular etiology obvious clinically, despite the presence of spinning vertigo, making our argument true, yet diagnostically immaterial. We know from well-documented case reports that sometimes there are no such cardiac clues in patients with arrhythmia¹¹ or even acute aortic dissection¹⁰. Furthermore, there was no mention of chest pain or dyspnea in our four studies of patients with syncope or orthostatic hypotension. Nevertheless, this remains a limitation.

Table 3. Relative Proportion of Vertigo in Relevant Studies* of Primary Cardiovascular Disorders, Listed in Order of Methodological Quality

CV population (citation)	CV subjects (n)	Dizzy subjects (n or range (median) †)	Proportion any vertigo (% (95% CI))	Only vertigo (n or range (median)‡)	Proportion only vertigo (% (95% CI))
Acute myocardial infarction [Culic, 2001 ¹⁶]	1,546	124–206 [165]	75 [68–82]	47–124 [86]	52 [44–60]
Orthostatic hypotension [Low, 1995 ¹⁷]	90	79–90 [85]	39 [28–50]	0–11 [6]	7.1 [2.8–15]
Carotid sinus syncope [Davies, 1979 ¹⁸]	23	6	67 [22–96]	4	67 [22–96]
TOTAL	1,659	209–302 [256]	63 [57–69]	51–139 [95]	37 [31–43]

CI=confidence interval; CV=cardiovascular

*Only three of five studies are included in this Table because the other two selected on vertigo as an entry criterion

†Data presented did not always permit an exact determination of the number of patients experiencing dizziness (e.g., data were available on the frequency of "vertigo" and the frequency of "faintness," but not on the overlap in these symptoms within a given patient). In such cases, a range of possible values (from maximum overlap to minimum overlap) has been calculated along with a median value used for subsequent calculations

‡Data presented did not always permit an exact determination of the number of patients experiencing *only* vertigo (as opposed to a combination of dizziness symptoms). In such cases, a range of possible values (from maximum to minimum overlap) has been calculated along with a median value used for subsequent calculations

Clinical Case Answer. In our 55 year old with episodic dizziness, the presence of *spinning vertigo* represents insufficient evidence to exclude cardiovascular causes. In this case, barring an adequate alternative explanation, cardiac arrhythmia should be investigated.

CONCLUSIONS

Our review indicates there is no published medical evidence to support the contention that vertiginous dizziness excludes an underlying cardiovascular etiology. This would be so even if our study revealed nothing at all about the frequency of vertigo in cardiovascular disease, but, instead, we found that, among those with dizziness of primary cardiovascular cause, vertigo may be a common symptom. Future research should assess, in an unbiased, prospective way, whether dizziness types (or other clinical variables) offer any predictive value with respect to underlying diagnosis or etiology. In the meantime, the presence of vertigo should not be relied upon to obviate the need for consideration of cardiovascular causes—particularly dangerous ones (e.g., myocardial infarction, cardiac arrhythmia), where diagnostic delay could prove lethal.

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#3. symptom*:ti,ab OR diagnosis:ti,ab OR complaint:ti,ab
#4. [english]/lim AND [1972–2007]/py
#5. #1 AND #2 AND #3 AND #4

Appendix 2. Exclusion coding schema for abstract and full-length manuscript reviews

APPENDIX

Appendix 1. Electronic search strategy

PubMed

((vertigo[mh] OR vertigo[tiab] OR dizziness[mh] OR dizziness [tiab]) AND (cardiovascular[tiab] OR myocardial[tiab] OR arrhythmia[mh] OR arrhythmia[tiab] OR syncope[tiab] OR presyncope[tiab] OR orthostatic[tiab]) AND (diagnosis[tiab] OR symptom*[tiab] OR complaint[tiab])) AND eng[la] AND 1972:2007[dp]

EMBASE (accessed via EMBASE.COM)

#1. vertigo:de OR dizziness:de OR vertigo:ti,ab OR dizziness: ti,ab
#2. 'heart arrhythmia':de OR cardiovascular:ti,ab OR myocardial:ti,ab OR syncope:ti,ab OR presyncope:ti,ab OR arrhythmia:ti,ab OR orthostatic:ti,ab

1	No data	Review paper, no original patient data
2	Not cv	Not a cardiovascular study (about schizophrenia, benign prostatic hypertrophy, urinary tract infection, gastroesophageal reflux, migraine, etc.)
3	Drug	Drug study with potential confounding exposure (cardiovascular, but drug administered that may have dizziness as a direct nervous system side effect, etc.)
4	Exp	Non-drug study with confounding exposure (spaceflight, anesthesia, multiple sclerosis, atrial fibrillation with possible transient ischemic attack, etc.)
5	No dx	No confirmed cardiovascular diagnosis (population study without individual diagnoses provided; no clear link between diagnosis and dizziness, etc.)
6	No sxs	No symptom data; no differentiation between types of dizziness; no reference to vertigo (or similar terms such as rotation, spinning, or motion), etc.
7	<5	Fewer than 5 subjects (total participants reported, including cases and controls)
8	Other	Any other reason abstract is not included