Changing Paradigm for Vertigo/Dizziness Patients: a Retrospective Before-After Study from Tertiary Hospitals in Northwestern China

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BACKGROUND: Single disciplinary management of patients with vertigo and dizziness is an important challenge for most physicians in China.

OBJECTIVE: To assess the impact of a new paradigm of practice (Clinic for Vertigo and Dizziness, CVD) performed by a multidisciplinary team (MDT) on diagnostic spectrum, medical costs, and patient satisfaction.

DESIGN: Retrospective before-after study.

PARTICIPANTS: Sample of 29,793 patients with vertigo/dizziness as primary complaint.

MEASURES: Changes in diagnostic spectrum, medical costs, and patient satisfaction before and after the establishment of a CVD based on a 4-year database in three tertiary hospitals in northwestern China.

KEY RESULTS: The most common diagnoses of patients with vertigo and dizziness were Meniere's disease (25.77%), cervical disease (25.00%), cerebral vascular disease (13.96%), vestibular syndrome (10.57%), and other etiologies (6.34%) before the CVD establishment. In contrast, after the CVD establishment, the most common diagnoses were BPPV (23.92%), vestibular migraine (15.83%), Meniere's disease (14.22%), CSD/PPPD (11.61%), and cerebral vascular diseases (4.45%). Extended implementation of a structured questionnaire for vertigo/dizziness and vestibular-oriented examinations (nystagmus, positional tests, HINTS) at the CVD resulted in a remarkable decline in the utility of CT/MRI and X-ray examination ($p < 0.001$). Meanwhile, medical costs in patients with vertigo/dizziness dropped by 11.5% ($p < 0.001$), with a significant improvement in patient satisfaction after the establishment of CVD ($p < 0.001$).

CONCLUSIONS AND RELEVANCE: Our study suggested that the MDT paradigm of CVD practice may facilitate the medical management of patients with vertigo/dizziness and improve patient satisfaction.

KEY WORDS: vertigo; dizziness; vestibular disorder; medical care; medical costs.

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INTRODUCTION

Vertigo and dizziness are multisensory symptoms of motion illusion, constitute one of the most common reasons for primary care,^{1,2} otology, neurology, and emergency consultation,^{3,4} and associated with extensive handicap and psychological morbidity among working age population,⁵ with a prevalence between 20 and 69.4% in the adult population.^{6,7} The causes of vertigo and dizziness cover a wide range of diseases from peripheral vestibular diseases and central nervous system diseases to psychiatric disorders;⁸ therefore, the interdisciplinary nature of the vestibular diseases as well as the obscure description of the symptoms by the patients in medical consultation has made the management of vertigo and dizziness a major challenge for most doctors.^{9–11} As such, multiple disciplinary teams dedicated for cost-effective management of vertigo and dizziness patients have emerged worldwide, most of which were embedded in neuro-otologic laboratories or vertigo and balance centers.¹² During the last few years, China has been undergoing a process of converting its existing single disciplinary paradigm into a multidisciplinary team (MDT) paradigm to better manage patients with vertigo and dizziness; however, the impact of the transformation was not clear regarding the spectrum of diagnosis, medical costs, and patient satisfaction.

With the advent of a series of guidelines and consensus concerning some major vestibular disorders in the spectrum of vertigo and dizziness diseases,¹³ and with continued knowledge production, the paradigm of management for the vertigo and dizziness disorders has been remarkably changed across the Chinese mainland. Some comprehensive hospitals began to establish specialized clinics to cope with vestibular disorders, often known as the Center/Clinic for Vertigo and

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Dizziness (CVD), in which a network of practitioners from neurology, otolaryngology, ophthalmology, and sometimes psychology was implemented. As a result, the landscape of the management for vertigo- and dizziness-related diseases changed to concord with the mainstream practices of the international community.¹⁴ In this study, we assessed the impact of the new paradigm of vertigo and dizziness management on the diagnostic spectrum, medical costs, and patient satisfaction.

METHODS

Clinical Settings

This retrospective before-after study was conducted at three tertiary hospitals, namely Shaanxi Provincial People's Hospital, Xinyuan Hospital of Yulin, and the First Municipal Hospital of Weinan in northwestern China. Due to the diverse nature of vestibular disorders, as well as the traditional practices in the management of vertigo and dizziness, patients with vestibular symptoms were usually triaged either to departments of neurology, otorhinolaryngology, orthopedics, ophthalmology, or psychology before the establishment of the Clinic for Vertigo and Dizziness (CVD). With the launch of the CVD designed to integrate different disciplinary professionals to work together under a set of consensual procedures based on the current wisdom in vestibular disorder research,¹⁵ it became possible for patients to be managed within the new one entity. This study protocol has been reviewed and approved by the Ethics Committee of Shaanxi Provincial People's Hospital.

Practices in CVD

Practices of professionals in CVD complied with a consensual paradigm to manage their patients (Table 1). The key points of the paradigm included the following: (1) a structured 12-item questionnaire¹⁶ either in printed version (Supplementary 1) or web-based version (<https://www.wjx.cn/jq/25649253.aspx>, for QR code entry, Supplementary 2); (2) a thorough physical examination, with emphasis on the vestibular-oriented examination, including nystagmus, vestibulo-ocular reflex (VOR), tuning fork test, Romberg and Fukuda test, bedside head impulse test (bHIT), Roll test, and Dix-Hallpike test¹⁷; (3) a necessary but well-focused instrumental examination according to the presumed diagnosis (e.g., only those patients with vestibular symptoms of possible central origin were recommended undertaking cranial MRI); and (4) each diagnosis and treatment was made according to up-to-date guidelines and consensus.^{13,18}

Data Collection

To assess the impact of the CVD paradigm on the patients with vestibular symptoms, we compared the diagnosis, medical costs, and patient satisfaction before and after the establishment of CVD. Data were extracted from 2-year clinical

Table 1 Consensus of Clinic for Vertigo and Dizziness Practices

Items	Requirement
Infrastructure	
Independent consultation room	Mandatory
Public registration	Mandatory
Digitally structured medical record system	Optional
Team	
Professionals in neurology	Mandatory
Professionals in otolaryngology	Mandatory
Professionals in psychiatrics	Optional
Professionals in ophthalmology	Optional
Specialists in vestibular examination	Mandatory
Vertigo/dizziness questionnaire	
Nature of the symptoms	Mandatory
Episode duration	Mandatory
Provoke factors	Mandatory
Accompanying symptoms	Mandatory
First or recurrent	Mandatory
Medical history	Mandatory
Vestibular-oriented physical examination	
Low-frequency fork test	Mandatory
Nystagmus and VOR	Mandatory
Bedside head impulse test	Mandatory
Romberg test and Fukuda test	Mandatory
Dix-Hallpike test and Roll test	Mandatory
Vestibular-oriented instrumental examinations	
Videonystagmography (VNG)	Mandatory
Video head impulse test (vHIT)	Optional
Electrocochleography	Optional
VEMP	Optional
Audiometry testing	Mandatory
Other examinations	
Autonomic function	Optional
External auditory canal endoscope	Mandatory
Laboratory investigation	Mandatory
Neuropsychological assessment	Mandatory
Neuroimage (CT/MRI)	Mandatory
TCD	Optional
Right-to-left shunt (TTE/TEE/cTCD)	Optional

VEMP, vestibular evoked myogenic potentials; TCD, transcranial Doppler; TTE, trans-thoracic echocardiogram; TEE, trans-esophageal echocardiogram; cTCD, contrast-enhanced transcranial Doppler

records prior to CVD establishment (pre-CVD) retrospectively, and the following 2-year records prospectively (post-CVD) from digitally structured medical databases of the abovementioned three tertiary hospitals during 2014–2018. All records with primary complaint of vestibular symptoms such as vertigo, dizziness, giddiness, unsteady, unbalance, or disequilibrium were included.

A crawler program was developed for data aggregation through scanning within the raw database of the hospital information system. Primary data were firstly stratified to collect records with vestibular symptoms as the primary complaint and cleaned with patients' identity card number as a unique identifier, discarding incomplete records and duplicated records. Direct medical costs were the sum costs arising from a patient's clinic registration, medical examination, and medication related to the diagnosis and treatment per visit, and adjusted by the officially published Consumer Price Index (CPI).

Outcome Measurements

Each patient with primary complaint of vestibular symptoms was assessed at the first visit and at the follow-up 1 month later

with the screening version of the Dizziness Handicap Inventory (DHI-S) developed by Jacobson et al. to reflect the severity of vestibular symptoms.^{19,20} A 1-month follow-up was conducted by either phone call or instant messaging based on the preference and availability of the patient. Patients' global satisfaction with symptoms relief and medical management was also assessed during the follow-up by a general 10-point visual analog scale (VAS).²¹ All the follow-ups were accomplished by medical staff in the hospital's follow-up center.

Statistical Analysis

Statistical analyses were performed with IBM SPSS 19. Results were expressed as mean $\pm$ SEM. For the comparison of ratio, the chi-square test was used. Normal distribution of DHI-S and VAS scores was verified by the Kolmogorov-Smirnov test. Differences of DHI-S and VAS between pre-CVD and post-CVD were tested with the one-way ANOVA. $p \leq 0.05$ was set as statistically significant.

RESULTS

Demographic Comparison

We totally identified 29,793 valid records of patients with primary complaint including vestibular symptoms from 2,385,287 eligible medical records, after discarding records with other primary complaints (1,847,432), uncompleted crucial data ($n = 142,749$), and duplicated records ($n = 365,313$) within the 4-year medical record database in the three hospitals (Fig. 1). The mean age of the patients was 54.1 years, and the male to female ratio of the subjects was 40.3% vs. 59.7%. Among them, 8.4% were admitted to emergency clinical setting. The proportion of patients with vertigo and dizziness episode history during the past 1 year was 12.9%. Proportions of vertigo and dizziness patients, age, gender distribution, vertigo and dizziness history, and proportion of emergency admission and baseline DHI-S showed no significant difference before and after the establishment of CVD (Table 2).

Changes in Diagnostic Spectrum of Vertigo and Dizziness Diseases

There was a significant change in the diagnostic spectrum after the establishment of CVD (Table 2). Top 5 diagnoses for the common vertigo and dizziness before CVD establishment in 2 years were Meniere's disease (25.77%), cervical disease (25.00%), cerebral vascular disease (13.96%), vestibular syndrome (10.57%), and other etiologies (6.34%). In contrast, benign paroxysmal positional vertigo (BPPV, 23.92%), vestibular migraine, Meniere's disease, chronic subjective dizziness (CSD)/persistent postural-perceptual dizziness (PPPD), and cerebral vascular diseases constituted the top 5 common diagnosis in the spectrum of vertigo and dizziness diseases. Notably, BPPV and vestibular migraine only constituted

1.43% and 1.69% respectively in the diagnosis before CVD establishment, which remarkably changed into 23.92% and 15.83%, respectively, as compared with pre-CVD ($p < 0.001$).

Differences in Medical Examination and Care in Vertigo and Dizziness

Well-established diagnosis of vertigo and dizziness diseases required a series of special medical examinations and protocols. As such, we compared the implementation of a vestibular-oriented physical examination and the utility of medical instruments. Results showed that the implementation of the structured questionnaire, the investigation of nystagmus, measurements of hearing ability with a tuning fork, bedside head impulse test, and positional test (Dix-Hallpike test and Roll test) were remarkably extended after CVD establishment as compared with before (Table 3). Meanwhile, the caloric test/ENG/VNG instrument was more frequently employed after CVD establishment ($p < 0.001$). The utility of CT/MRI and cervical X-ray, however, was greatly reduced as compared with post-CVD ($p < 0.001$) (Table 3).

Effects of CVD on Medical Costs and Patient Satisfaction

There was no significance in hospitalization rate before and after CVD establishment (Table 3). However, there was a marked drop (11.5%) of adjusted direct medical costs after CVD establishment (CNY 361.17 for pre-CVD to CNY 319.64 for post-CVD, $p < 0.001$) (Table 3). The 1-month global satisfaction of patients was significantly improved in the 10-point VAS satisfaction survey (from 8.66 to 9.17). The severity of vestibular symptoms as indicated by follow-up DHI-S decreased markedly from 5.35 for pre-CVD to 2.21 for post-CVD ($p < 0.001$) (Table 3).

DISCUSSION

Vertigo and dizziness are the most common symptoms among the clinical complaints, with a 1-year prevalence of 5% in the general population.²² The diagnosis and management of vertigo and dizziness is a major challenge for physicians because the etiologies of vertigo and dizziness are presented with a wide variety of diseases due to the interdisciplinary nature of vestibular disorders,²³ and also for patients, the indescribability behind varied vestibular and non-vestibular symptoms. As such, a systemic optimization of medical management for vertigo and dizziness patients was crucially required. For this purpose, we adopted a new paradigm of practice which emphasized integrated multidisciplinary teamwork, structured medical history inquiry, and vestibular-oriented physical examinations, by the establishment of a comprehensive hospital-based center for vertigo and dizziness. We compared the impact of CVD on the clinical landscape of vertigo and dizziness patients, and found that the practices of CVD

Figure 1 Flowchart of the data collection.

remarkably changed the diagnostic spectrum of vestibular diseases, improved the patient's satisfaction, and greatly lowered direct medical costs.

The better management of the patients with vestibular disorders relies much on the appropriate diagnosis of vestibular symptoms which could be achieved by the implementation of guidelines and census in this field through a patient's identification of symptomatic features, physical and instrumental examinations, and diagnostic conceptions. The diagnostic spectrum of vestibular diseases in a large-scale cohort was rather steady in a hospital,⁸ and tended to be consistent across the distribution spectrum,^{24,25} which may reflect the systemic

properness of diagnosis in the hospital. For example, BPPV as one of the commonest vestibular disorders in the vertigo and dizziness diagnostic spectrum has been well established by multiple studies.^{4,26} However, before establishment of CVD, BPPV ranked far beyond the tenth, having only 1.43% proportion among all the vertigo and dizziness diseases. Given that the positional test including the Dix-Hallpike test and Roll test is necessary for the identification of BPPV,²⁶ the low rate (4.6%) of positional tests before CVD establishment might explain the extremely low rate of BPPV. With the emphasis on the positional tests after CVD establishment, the implementation of positional tests significantly increased to 81.9%, and

Table 2 Demographic Data and Diagnostic Spectrum of Patients with Vertigo and Dizziness

	Pre-CVD (n = 12,516)	Post-CVD (n = 17,277)	p
Character			
Male/female [n (%)]	4882 (39.0)/ 7634 (61.0)	7118 (41.2)/ 10,159 (58.8)	0.692
Age (years) [mean ± SD]	55.4 ± 17.6	53.8 ± 18.1	0.553
Emergency admission [n (%)]	1014 (8.1)	1503 (8.7)	0.062 [#]
History of vertigo [n (%)]	1639 (13.1)	2211 (12.8)	0.449 [#]
Baseline DHI-S	22.76 ± 11.43	23.12 ± 12.15	0.680
Diagnosis			
BPPV	179 (1.43%)	4133 (23.92%)	0.000
Vestibular migraine	211 (1.69%)	2735 (15.83%)	0.000
Meniere's disease	3225 (25.77%)	2457 (14.22%)	0.000
CSD/PPPD	586 (4.68%)	2005 (11.61%)	0.000
Cerebral vascular diseases	1747 (13.96%)	768 (4.45%)	0.000
Uni-peripheral vestibulopathy	312 (2.49%)	725 (4.20%)	0.000
Bi-peripheral vestibulopathy	109 (0.87%)	652 (3.77%)	0.000
Benign paroxysmal vertigo	35 (0.28%)	531 (3.07%)	0.000
Vestibular neuritis	13 (0.10%)	367 (2.12%)	0.000
Polyneuropathy	115 (0.92%)	375 (2.17%)	0.000
Drug related	211 (1.69%)	268 (1.55%)	0.363
Sudden hearing loss	198 (1.58%)	255 (1.48%)	0.462
Vestibular paroxysmia	0 (0.00%)	182 (1.05%)	0.000
Cervical disease	3129 (25.00%)	166 (0.96%)	0.000
Vestibular syndrome	1323 (10.57%)	223 (1.29%)	0.000
Other etiologies	793 (6.34%)	996 (5.76%)	0.044
Unidentified	331 (2.64%)	439 (2.54%)	0.282

CVD, Clinic/Center for Vertigo and Dizziness; DHI-S, screening version of the Dizziness Handicap Inventory; BPPV, benign paroxysmal positional vertigo; CSD, chronic subjective dizziness; PPPD, persistent postural-perceptual dizziness

[#]Chi-square tests

Table 3 Examination Category and Outcomes of the Patients

	Pre-CVD (n = 12,516)	Post-CVD (n = 17,277)	p
Examination and care			
Structured questionnaire	391 (3.12%)	14,217 (82.3%)	0.000
Nystagmus	1652 (13.2%)	15,194 (87.9%)	0.000
Hearing	1334 (10.7%)	8896 (51.5%)	0.000
Head impulse test/HINTS	1134 (9.1%)	15,332 (88.7%)	0.000
Positional tests	578 (4.6%)	14,152 (81.9%)	0.000
CT/MRI (brain, cervical)	8851 (70.7%)	5398 (31.2%)	0.000
X-ray (cervical)	3025 (24.2%)	894 (5.2%)	0.000
Caloric test/ENG/VNG	2133 (17.0%)	14,082 (81.5%)	0.000
Outcomes			
Hospitalization rate	1349 (10.8%)	1894 (10.9%)	0.624
Medical costs per visit (CNY)	361.17	319.64	0.000
Follow-up DHI-S	5.35 ± 3.92	2.21 ± 1.79	0.000
Satisfaction VAS	8.66 ± 3.55	9.17 ± 3.41	0.000

HINTS, head impulse, nystagmus, and test of skew; ENG, electro-nystagmography; VNG, videonystagmography; VAS, visual analog scale

accordingly, the diagnosis of BPPV remarkably moved up to the top one (23.92%) in the diagnostic spectrum, which accorded well with most of other literatures.^{6,8}

It has been increasingly accepted that the diagnosis of cervicogenic dizziness was rare in vertigo and dizziness population, which was challenged by the finding that most of the complaints presumably diagnosed as cervicogenic dizziness were lately verified as BPPV or other specific diagnoses.²⁷ However, the proportion of cervicogenic dizziness before the CVD establishment unusually reached up to 25% in our study. Further investigation revealed that among those patients diagnosed with cervicogenic dizziness, only 3.42% had definite neck pain (data not shown), suggesting that the diagnosis of cervicogenic dizziness was extremely over-diagnosed in the clinical practice before CVD establishment. As compared with pre-CVD days in these hospitals, the implementation of the new diagnostic paradigm in post-CVD brought the proportion down to 0.96%, which was in accordance with recent literature.²⁸

Surprisingly, the diagnosis of vestibular syndrome took a proportion as high as 10.57% before CVD establishment, though it is not a specific entity of diagnosis, none bearing a diagnostic code in ICD-10 or ICD-11. Symptomatic diagnosis of vertigo and dizziness disorders rendered an obscure clinical judgment which would mislead unspecific treatment and compromise the outcome of these patients, thus should be avoided in the clinical practice in the management of vestibular disorders. To this purpose, we implemented a diagnostic framework according ICD-10/11 and a series of guidelines and document (International Classification of Vestibular Disorders, ICVD)²⁹ issued by the Bárány Society to instruct the diagnostic practices in CVD. Consequently, the proportion of diagnosis of vestibular syndrome has been dropped to 1.29%. Similarly, the remarkable changes within the diagnostic spectrum of vestibular disorders such as vestibular migraine, CSD/PPPD, benign paroxysmal vertigo, and vestibular paroxysmia may reflect the contribution of the implementation of the new diagnostic paradigm and the adoption of international-accepted guidelines and consensus within this quickly growing field.

A detailed collection of medical history would be beneficial to the diagnosis of most vertigo/dizziness diseases.^{15,30,31} Structured questionnaires have been proposed in the diagnostic process in the patients with vertigo and dizziness.^{16,32} Recently, a 6-item questionnaire has been used in the diagnosis of BPPV with considerable accuracy.³³ On the above basis, we proposed a structured questionnaire covering multiple domains of the medical history including the nature of the symptoms, duration, trigger factors, associated symptoms, episodic feature, comorbidity, and medication (Supplementary 1), through which most of the primary diagnosis could be substantially established.

Notably, the utility of medical imaging such as CT/MRI, Doppler test, and cervical X-ray remarkably decreased in post-CVD, accompanying a significant increase on the adoption for crucial bedside examinations such as head impulse,

nystagmus, and test of skew (HINTS) and positional tests. It has been reported that CT/CTA/MRI was heavily utilized along with underutilized bedside examination in emergency clinical setting. Bedside physical examinations have been proven to be able to narrow the medical imaging utility and thus facilitate the diagnostic process and lower the medical costs.³⁴ For example, HINTS, an underutilized bedside examination in most clinical settings, has been proven to effectively discriminate central from peripheral origin of vertigo and dizziness with substantial accuracy and cost-saving.³⁵ In our study, the implementation rate of HINTS elevated from 9.1% in pre-CVD up to 88.7% in post-CVD. Given that there was a high proportion of emergency admission (8.4%) in our study, the wide adoption of the crucial bedside examinations would greatly facilitate the diagnostic accuracy and efficiency in clinical practice.

Multidimensional outcomes such as hospitalization, direct medical costs, symptomatic relief, and patient satisfaction were complicatedly influenced by many factors, some of which were linked with external factors and the disease itself,³⁶ but major factors were profoundly linked with medical service the patients received.^{37,38} A proper diagnosis, time- and cost-saving medical service, and disease relief often lead to a higher patient satisfaction. In this study, similar hospitalization rates before and after CVD establishment were accompanied with a remarkable decrease of direct medical costs by 11.5%, as compared with pre-CVD period. Meanwhile, symptomatic reliefs of the patients in response to medical service implemented with CVD practice show a significant improvement, as indicated by follow-up DHI-S scores. As a result, there was a notable improvement (by 5.9%) in patient satisfaction as indicated in the global satisfaction questionnaire. Taken together, our study highlighted a significant positive contribution of CVD practice to the multidomain outcomes in patients with vertigo and dizziness.

LIMITATIONS

The present study focused on the comparison of the two different management paradigms and the impact on the clinical outcomes of patients presenting with vertigo and dizziness symptoms in multicentered tertiary hospital settings. However, the results could have been limited by the retrospective nature of the study; further prospective evidence and validation of the proposed practice and paradigm is needed before adopting them widely in practice.

CONCLUSION

Our study supported that the MDT paradigm of CVD practice incorporating current conception of vestibular medicine, structured questionnaire, and vestibular-targeted examination may facilitate the medical management of patients with vertigo and dizziness and improve patient satisfaction.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11606-020-06475-w>.

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Authors' Contribution All authors made substantial contributions to the study design, data acquisition, and analysis as well as manuscript preparation.

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Compliance with Ethical Standards:

This study has been reviewed and approved by the Ethics Committee of Shaanxi Provincial People's Hospital.

Conflict of Interest: The authors declare that they do not have a conflict of interest.

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