International Journal of Cardiology 183 (2015) 54–62

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Disparate assessment of clinic blood pressure and ambulatory blood pressure in differently aged patients with chronic kidney disease

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ARTICLE INFO

Article history:
Received 21 July 2014
Received in revised form 23 October 2014
Accepted 25 January 2015
Available online 27 January 2015

Keywords:
Ambulatory blood pressure monitoring
Clinic blood pressure
Chronic kidney disease

ABSTRACT

Background: Ambulatory blood pressure monitoring (ABPM) is recommended to assess hypertensive status in patients with chronic kidney disease (CKD). However, the difference in blood pressure (BP) based on clinic and ambulatory monitoring in CKD patients of different ages is not known.
Methods: We recruited 1116 CKD patients admitted to our hospital division and referred with data in this cross-sectional study. Patients were divided into three groups: young, middle age and old. Inter-method agreement between clinic BP and ABPM in different age groups was assessed using the Kappa (κ) coefficient. Linear and logistic regression analyses were used to evaluate renal and cardiovascular parameters.
Results: κ coefficient for inter-method agreement between clinic BP and ABP in patients from young, middle-age and old groups was 0.472 ($p < 0.001$), 0.335 ($p < 0.001$) and 0.102 ($p = 0.086$), respectively. Age was the main factor determining the difference in clinic BP and ABP by multiple linear regression analyses. Prevalence of masked hypertension in older patients was higher than that in young and middle-age patients ($p < 0.001$), and age was associated with the onset of masked hypertension. Age and ABP were independently correlated with estimated glomerular filtration rate (eGFR) and left ventricular mass index (LVMI), whereas age and clinic BP were associated with carotid intima media thickness (cIMT) by linear and logistic regression analyses.
Conclusions: We have provided evidence of disparate assessment of the diagnosis and correlation with TOD from clinic BP and ABP in untreated, different-aged, CKD patients. Good-quality, long-term, large longitudinal trials are needed to validate the role of ABPM for Chinese CKD patients.

1. Introduction

Chronic kidney disease (CKD) has become an important public-health problem in China. The number of patients with CKD in China is ≈119.5 million based on the fact that the prevalence of CKD in China is 10.8% [1]. CKD confers a high risk of complications, such as end-stage renal failure and cardiovascular events [2]. Hypertension is an important modifiable risk factor for these complications [3]. Blood pressure (BP) control can slow the decline of kidney function and reduce the risk of cardiovascular disease (CVD) [4].

Accurate measurement of BP remains crucial for the diagnosis and management of BP in patients with CKD. Elevated BP in the clinic is an important risk factor for CKD and CVD, and is measured routinely. Recent evidence, however, suggests that ambulatory blood pressure monitoring (ABPM) might be a better tool to classify hypertensive status and risk of adverse events [5,6]. Clinic BP is not predictive of cardiovascular mortality after adjustment for ambulatory blood pressure (ABP) [7], and ABP is a stronger predictor of end-stage renal disease (ESRD) or death than clinic BP [8]. A recent consensus statement by several European and American societies has recommended that ABPM should be used for the diagnosis of hypertension in persons at risk for cardiovascular events, such as those with CKD [9].

However, use of ABPM on a regular basis in the clinical setting has practical limitations due to expense and patient compliance, which might limit use in CKD patients (especially in “developing” countries). It is important to explore the difference between BP measurement in the clinic and ABPM on the diagnosis and assessment in CKD patients. However, few studies have explored the difference between clinic BP and ABPM in CKD patients [10–12]. Nevertheless, an inherent limitation is use of different types of antihypertensive drugs in such studies.

Elderly patients represent an ever-growing subgroup of the China population [13]. Data published by the United Nations revealed that, in 2010, individuals aged ≥60 years constituted 12.3% of the population, and this subgroup will constitute 29.7% of the population by 2050 [14]. BP tends to increase with age, and hypertension is exceedingly common in the elderly, with an estimated prevalence of 67% for adults aged ≥60 years [15]. Also, in adults aged 55–65 years, the lifetime risk of developing hypertension is ≈90% [16].

Our previous study suggested that age is independently correlated with the estimated glomerular filtration rate (eGFR), proteinuria and

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http://dx.doi.org/10.1016/j.ijcard.2015.01.051
0167-5273/

reverse dipper pattern of blood pressure in Chinese CKD patients [17]. We believe that age could play a key part in CKD and CVD based on previous data. We hypothesized that disparate measurements of BP would be found from clinic BP and ABP in CKD patients of different ages, and so carried out cross-sectional analyses to test this hypothesis.

2. Materials and methods

2.1. Study population

The study protocol was approved by the ethics committee of the Third Hospital of Sun Yat-Sen University (Guangdong, China). All of the study participants provided written informed consent to be included in the study (Fig. 1).

From May 2010 to April 2014, 1534 consecutive CKD inpatients who were not being treated formed the cohort for this cross-sectional study. Exclusion criteria were: undergoing treatment with corticosteroids or hormones; acute changes in the eGFR >30% in the previous three months; pregnancy; history of abuse of drugs or alcohol; night work or shift-work employment; acquired immunodeficiency syndrome; cardiovascular disorders (unstable angina pectoris, heart failure, life-threatening arrhythmia, atrial fibrillation and grade III–IV retinopathy); intolerance to ABPM; inability to communicate and comply with all of the study requirements; on maintenance dialysis; being in receipt of any antihypertensive drug in the previous month.

A total of 306 patients were ruled out because they had undergone some type of antihypertensive treatment. One-hundred and twelve patients were excluded due to deficiency of clinical or ultrasonographic data.

Finally, 1116 CKD patients were enrolled in this study. In terms of causes of renal diseases: 612 patients had chronic glomerulonephritis; 155 cases had diabetic nephropathy; 53 subjects had hypertensive nephropathy; 93 patients had lupus nephritis; 203 patients had other causes of renal disease. We divided these patients into three groups based on age: young (<45 years), middle age (≥45 years but <60 years) and old (≥60 years) [14].

2.2. Measurements

2.2.1. ABPM

Patients underwent 24-h ABPM using a TM-2430 Monitor (A&D, Tokyo, Japan). Cuff size was chosen based on arm circumference and fixed to the non-dominant arm. BP readings were obtained in the morning at three points from 7 am to 10 am using a mercury sphygmomanometer by a physician who did not have access to ABP values. Then BP was recorded every 15 min from 7 am to 10 pm, and every 30 min from 10 pm to 7 am. Monitoring was done on a working day. Patients were asked to attend to their usual activities but to keep motionless at the time of measurement. Patients had no access to ABP values. Strenuous physical activity was discouraged in all patients during the monitoring period, and their daily activities were comparable. BP series were eliminated from the analyses if: >30% of the measurements were lacking; they had missing data for >3-h spans; they were collected from subjects who were experiencing an irregular rest–activity schedule or a night-time sleep span <6 h or >12 h during monitoring.

2.2.2. BP measurement in the clinic

BP was measured for each patient during a visit to the physician [18]. Briefly, measurements were taken in a quiet environment using a mercury sphygmomanometer with the patient in a sitting position after 5 min of rest. BP was not measured if the patient had consumed tobacco, ingested caffeine, or eaten within the previous 30 min. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) values (Korotkoff's phase I and phase V, respectively) at each visit enabled recording of a minimum of three BP measurements at intervals of ≥1 min. Reported values of clinic BP were the mean of values recorded during the two days in which the ABPM device was installed and removed. For all patients, sphygmomanometric measurements were recorded by the same physician, who was not aware of the results of ABP recordings.

2.2.3. Cardiac assessment

Cardiac structure was assessed by two investigators trained for this purpose before starting the study. Left ventricular mass (LVM), systolic function, and diastolic function were assessed using two-dimensional echocardiography. Linear measurements of end-diastolic interventricular septal wall thickness (IVSd), end-diastolic left ventricular internal dimension (LVIDd), and end-diastolic posterior wall thickness (PWTd) were obtained from M-mode tracings. LVM was calculated using the following formula [19]:

$$\mathrm{LVM} = \left\{1.04 \times (\mathrm{IVSd} + \mathrm{LVIDd} + \mathrm{PWTd})^3 – \mathrm{LVIDd}^3\right\} \times 0.8 + 0.6.$$

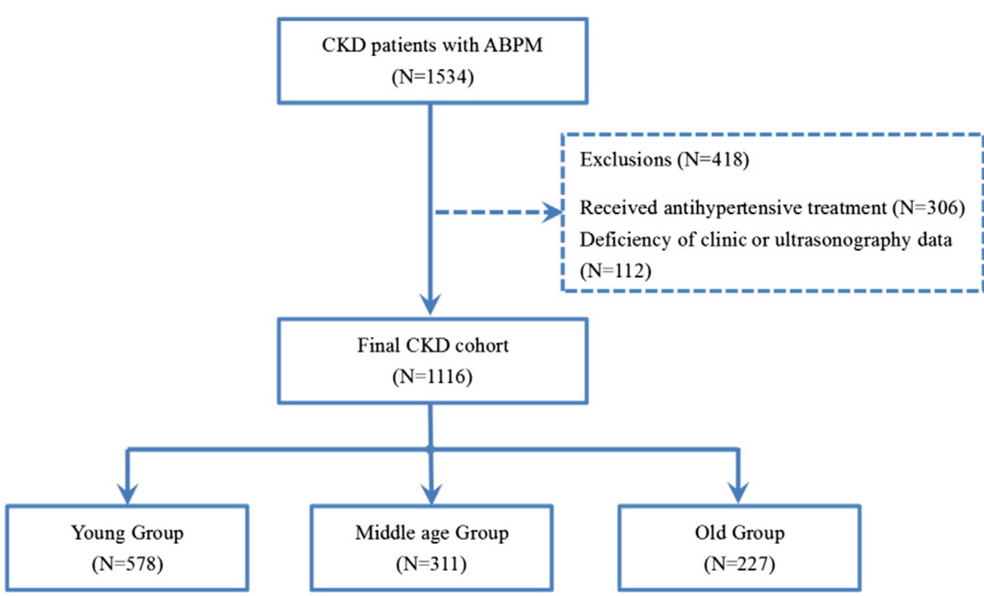

Fig. 1. Patient selection and assignment to different age groups.