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Bundle branch block and nonspecific intraventricular conduction delay prevalence using Chinese nationwide survey data

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Abstract

Objective: We aimed to determine the prevalence of and the factors associated with intraventricular conduction disturbance in the Chinese population.

Methods: Electrocardiographic data from 42,031 people were retrospectively analysed. The weighted prevalences of left bundle branch block (LBBB), right bundle branch block (RBBB), bifascicular block and nonspecific intraventricular conduction delay (NS-IVCD) were calculated. The independently associated factors were determined using logistic regression analysis.

Results: The weighted prevalence for Chinese people older than 45 years was 0.17% for LBBB, 2.16% for RBBB and 0.44% for NS-IVCD. The weighted prevalence for RBBB combined with left anterior fascicular block was 0.17%, and 0.05% for RBBB combined with left posterior fascicular block. There were significant differences in the weighted prevalences of RBBB and NS-IVCD between men and women. The weighted prevalence of LBBB and RBBB increased markedly with increasing age. Age and diabetes were independent factors associated with LBBB, compared with age and sex for RBBB and sex and coronary artery disease for NS-IVCD.

Conclusions: This study provided reliable data for the weighted prevalence of and factors associated with LBBB, RBBB and NS-IVCD in Chinese adults.

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Introduction

Electromechanical synchrony is important to preserve normal cardiac function; however, synchrony can be destroyed by intraventricular conduction disturbance (IVCD). IVCD is associated with increased mortality in patients with heart diseases, especially in those with myocardial infarction or heart failure.[1,2]

Left bundle branch block (LBBB) is the most pathogenic conduction disturbance because this condition can cause left ventricular dysfunction and even dilatation.[3–6] In contrast, isolated right bundle branch block (RBBB) is usually considered benign.[5–7] However, if RBBB is present with left anterior or posterior fascicular block (bifascicular block), the prognosis is poor.[8] Published data also support the adverse influence of nonspecific IVCD (NS-IVCD).[5,6] However, there are insufficient data regarding the prevalence and the factors independently associated with BBB and NS-IVCD. We conducted the current study to address this issue.

Methods

Design and study population

The China Atrial Fibrillation Epidemiologic Study was a cross-sectional study performed between 2014 and 2016. Briefly, a representative sample of 47,841 adults (age ≥45 years) from the general population in China was obtained through a two-stage, stratified cluster sampling design.[9] The details of the sampling methods were described previously.[9] Among the 47,841 participants, 42,031 (87.9%) people completed a standard 12-lead electrocardiogram (ECG). All 42,031 digital electrocardiograms were stored in the Muse database. In our present retrospective study, all electrocardiograms with QRS duration ≥120 ms were extracted from the database and analysed by a professional cardiologist, then the results were checked by another professional cardiologist. Data for sociodemographic information, medical history, lifestyle factors and laboratory tests were identified and matched from the database of the China Atrial Fibrillation Epidemiologic Study.[9] The ethics committee of Beijing Anzhen Hospital approved this research protocol (approval number: D111107300035). Written informed consent was obtained from each participant during recruitment for the China Atrial Fibrillation Epidemiologic Study. We de-identified all patients' details. The reporting of this research conforms to the STROBE guidelines.[10]

Definitions

LBBB, RBBB, NS-IVCD and fascicular conduction block were defined and diagnosed in accordance with the Minnesota codes and 2009 American Heart Association/American College of Cardiology Foundation/ Heart Rhythm Society (AHA/ACCF/HRS) recommendations.[11] The diagnostic criteria for LBBB comprised the following: 1) QRS duration ≥120 ms; 2) broad notched or slurred

R wave in leads I, aVL, V5 and V6; 3) absent q waves in leads I, V5 and V6 and 4) R peak time ≥60 ms in leads V5 and V6. The following were the diagnostic criteria for RBBB: 1) QRS duration ≥120 ms; 2) rsr′, rsR′ or rSR′ in leads V1 or V2. The R′ or r′ deflection is usually wider than that of the initial r wave. In a minority of patients, a wide and often notched R wave pattern (absence of an s/S wave) may be seen in lead V1 and/or V2 and 3) S wave of greater duration than that of the R wave or ≥40 ms in leads I and V6. Bifascicular block was defined as RBBB with left anterior or posterior fascicular block. Left anterior fascicular block (LAFB) was defined as follows: 1) frontal plane axis between −45° and −90°; 2) qR pattern in lead aVL and 3) R-peak time in lead aVL of ≥45 ms. Left posterior fascicular block (LPFB) was defined as follows: 1) frontal plane axis between 90° and 180°; 2) rS pattern in leads I and aVL and 3) qR pattern in leads III and aVF. NS-IVCD was defined as QRS duration ≥120 ms when both RBBB and LBBB were excluded.

Typical electrocardiograms are provided in the appendix, illustrating the diagnostic criteria of the different intraventricular conduction disorders.

Statistical analysis

Prevalence and risk factors were estimated with a sampling weight, non-response weight and population weight (age and sex), in accordance with the China Atrial Fibrillation Epidemiologic Study.[9] Prevalence was compared between age groups and between sex groups using the chi-square test. Categorical variables were also compared with the chi-square test. Logistic regression analysis was used to identify the independent factors associated with a specific type of IVCD. All *P*-values were two-sided, with a standard significance level (<0.05). All analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results

Among 1083 people with QRS duration ≥120 ms, there were 80 cases of LBBB, 804 cases of RBBB and 141 cases of NS-IVCD. The remaining 58 cases comprised 24 people with ventricular preexcitation, 30 people with ventricular pacing and 4 people with ventricular rhythm.

Prevalence of BBB and NS-IVCD

As shown in Figure 1, the weighted prevalence in Chinese people older than 45 years of age was 0.17% for LBBB, 2.16% for RBBB and 0.44% for NS-IVCD.

As shown in Figure 2, there was no significant difference in the weighted prevalence of LBBB between men and women. However, men had a higher weighted prevalence of both RBBB ($P < 0.0001$) and NS-IVCD ($P < 0.0001$) compared with women.

As shown in Figure 3, The weighted prevalence increased markedly with increasing age, for LBBB ($P < 0.0001$) and RBBB ($P < 0.0001$). However, there was no significant difference in the weighted prevalence of NS-IVCD between the age groups.

As shown in Figure 4, The weighted prevalence for RBBB combined with LAFB was 0.17%, compared with 0.05% for RBBB combined with LPFB. In other words, 7.8% of the people with RBBB had LAFB, and 2.3% of the people with RBBB had LPFB.

Factors associated with BBB and NS-IVCD

Univariate and subsequent multivariate logistic regression models were used to identify the factors independently associated with LBBB, RBBB and NS-IVCD (Tables 1–3). Sex, age, body mass index (BMI), sedentary lifestyle, smoking, alcohol drinking, hypertension, diabetes mellitus,

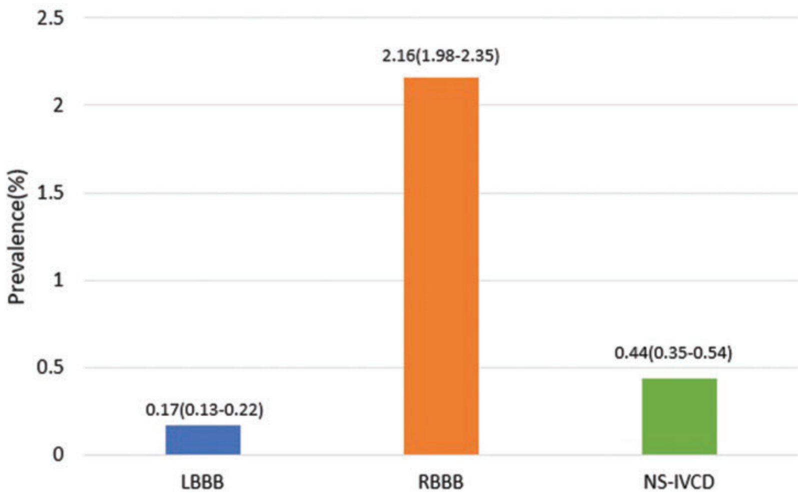

Figure 1. Weighted prevalence of left bundle branch block, right bundle branch block and nonspecific intraventricular conduction delay.
LBBB, left bundle branch block; RBBB, right bundle branch block; NS-IVCD, nonspecific intraventricular conduction delay.

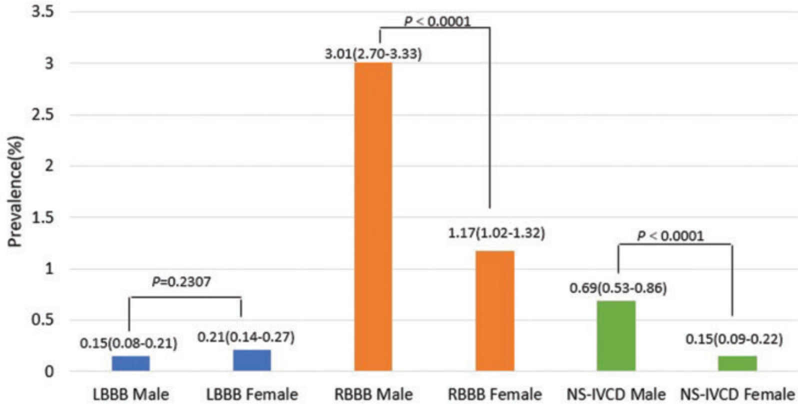

Figure 2. Weighted prevalence of left bundle branch block, right bundle branch block and nonspecific intraventricular conduction delay, according to sex.
LBBB, left bundle branch block; RBBB, right bundle branch block; NS-IVCD, nonspecific intraventricular conduction delay.

dyslipidaemia, coronary artery disease (CAD), stroke and estimated glomerular filtration rate (eGFR, estimated as $175 \times$ serum creatinine $(\text{Scr})^{-1.234} \times \text{age}^{-0.179}$ [if female, $\times 0.79$]) were considered as possible factors. Age and diabetes were independently associated with LBBB. In addition to age, sex was also independently associated with RBBB. Regarding NS-IVCD, sex and CAD were independently associated factors.

Discussion

Using the nationally representative, community-based, China Atrial Fibrillation

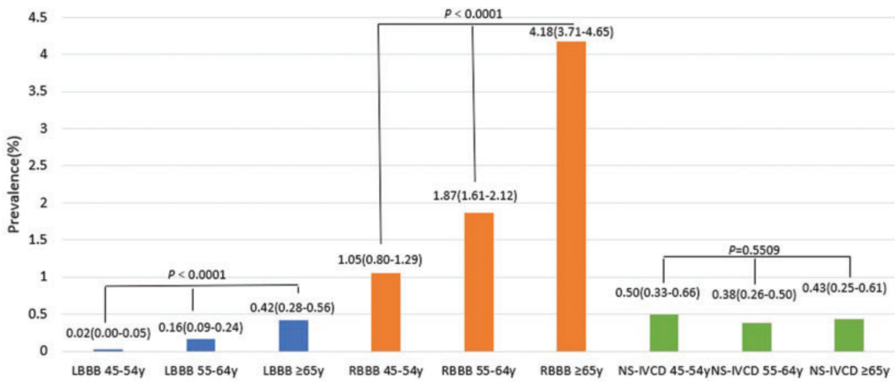

Figure 3. Weighted prevalence of left bundle branch block, right bundle branch block and nonspecific intraventricular conduction delay, according to age.
LBBB, left bundle branch block; RBBB, right bundle branch block; NS-IVCD, nonspecific intraventricular conduction delay.

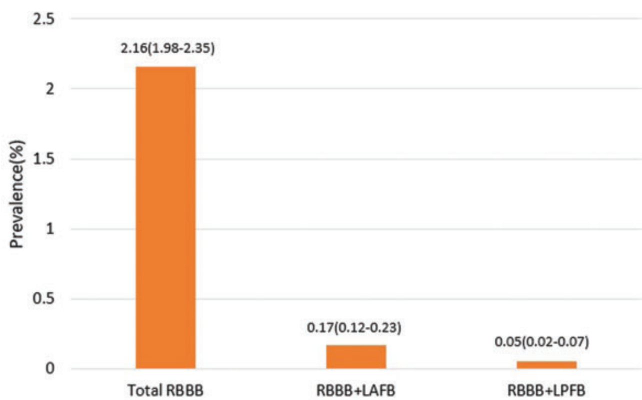

Figure 4. Weighted prevalence of two types of bifascicular block compared with the prevalence of total right bundle branch block.
LBBB, left bundle branch block; LAFB, left anterior fascicular block; LPFB, left posterior fascicular block.

Table 1. Logistic regression analyses of the factors associated with left bundle branch block.

	Univariate analysis		Multivariate analysis	
Factor	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Age	1.086 (1.063–1.019)	<0.0001	1.074 (1.041–1.108)	<0.0001
Smoking	0.433 (0.206–0.908)	0.0267	0.712 (0.293–1.732)	0.4537
Hypertension	3.217 (1.778–5.821)	0.0001	1.738 (0.943–3.205)	0.0764
Diabetes	2.808 (1.569–5.025)	0.0005	2.070 (1.149–3.732)	0.0155
eGFR	0.984 (0.973–0.994)	0.0029	0.996 (0.985–1.008)	0.5472

OR, odds ratio; CI, confidence interval; eGFR, estimated glomerular filtration rate.

Table 2. Logistic regression analyses of the factors associated with right bundle branch block.

	Univariate analysis		Multivariate analysis	
Factor	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Age	1.059 (1.050–1.068)	<0.0001	1.057 (1.048–1.067)	<0.0001
Female	0.380 (0.321–0.450)	<0.0001	0.455 (0.373–0.556)	<0.0001
Sedentary lifestyle	1.397 (1.147–1.700)	0.0009	1.120 (0.910–1.378)	0.2837
Smoking	1.358 (1.119–1.647)	0.0020	1.122 (0.898–1.401)	0.3117
Alcohol Drinker	1.282 (1.052–1.563)	0.0138	1.083 (0.869–1.350)	0.4760
Hypertension	1.477 (1.238–1.763)	<0.0001	1.032 (0.856–1.244)	0.7424
Diabetes	1.423 (1.109–1.826)	0.0055	1.209 (0.933–1.567)	0.1504
CAD	1.977 (1.325–2.950)	0.0008	1.249 (0.817–1.908)	0.3045
Stroke	1.317 (1.024–1.694)	0.0319	1.003 (0.763–1.318)	0.9844
eGFR	0.988 (0.984–0.992)	<0.0001	0.999 (0.995–1.003)	0.5859

OR, odds ratio; CI, confidence interval; CAD, coronary artery disease; eGFR, estimated glomerular filtration rate.

Table 3. Logistic regression analyses of the factors associated with nonspecific intraventricular conduction delay.

	Univariate analysis		Multivariate analysis	
Factor	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Female	0.220 (0.138–0.352)	<0.0001	0.235 (0.141–0.391)	<0.0001
Sedentary	1.575 (1.031–2.407)	0.0356	1.226 (0.792–1.897)	0.3602
Smoker	1.622 (1.055–2.495)	0.0275	0.838 (0.505–1.392)	0.4953
Alcohol drinker	1.635 (1.041–2.566)	0.0327	1.145 (0.681–1.924)	0.6107
CAD	3.596 (1.884–6.863)	0.0001	3.331 (1.718–6.460)	0.0004

OR, odds ratio; CI, confidence interval; CAD, coronary artery disease.

Epidemiologic Study data, we obtained reliable prevalence data and determined the factors independently associated with BBB and NS-IVCD in Chinese adults older than 45 years of age. We identified five previous epidemiologic studies of BBB[12–16] and three previous studies of NS-IVCD. However, few of these studies had sample sizes as large as that in our study. Regarding LBBB, the prevalence in western countries (USA, Finland, Ireland and Switzerland) was consistently higher than that in Asian countries (Japan, China).[12–16] As with our results, most studies showed similar prevalences in men and women (USA, Finland, Ireland, Switzerland and Japan), except for the previously published Chinese study.[12–16] The Chinese study analysed electrocardiographic data recorded in a national diabetes survey, in which more than a quarter of the participants did not undergo electrocardiography.[15] Thus, there might be remarkable selective bias in the previous Chinese study. The relationship between age and the prevalence of LBBB was confirmed in our study, similar to the findings in most previous studies.[12,13,15,16] Similar to the results of a Japanese study, we found that diabetes was an independently associated factor for LBBB.[12] Age is not modifiable; however, diabetes is a modifiable risk factor. In our opinion, diabetes likely damages specialised conduction systems, directly or indirectly.

The prevalence of RBBB on the basis of our analyses was comparable to that reported for American, Swiss and Japanese populations; however, the prevalence in our study was noticeably higher than that reported in the Finnish population.[12,13,16] Consistent with the results reported in American, Swiss and Japanese populations, sex and age were factors independently associated with RBBB. In patients with isolated RBBB, the progression to advanced atrioventricular block is rare.[14] However, patients with bifascicular block have an 11% 5-year incidence of progression to advanced atrioventricular block.[8] Our results are the first to provide a credible prevalence for bifascicular block, which was approximately one-tenth of the prevalence of RBBB.

The prevalence of NS-IVCD shown by our data was between that reported in a Finnish/Swiss study and that in a previously published Chinese study.[13,15,16] Similar to the Finnish/Swiss study, our data indicated that men are more likely to have NS-IVCD.[13,16] Our data are the first to show an independent relationship between CAD and NS-IVCD. These findings indicate the possibility of preventing NS-IVCD by controlling the risk factors for CAD, as well as the necessity to screen for CAD when patients have both NS-IVCD and risk factors for atherosclerosis.

Limitations

While cities and provinces were selected randomly in the seven regions of China in the China Atrial Fibrillation Epidemiologic Study, the communities and villages within each region were selected on the basis of feasibility of access, with subsequent units further selected on the basis of the sampling weights of the population census data. As such, our study may have been limited to some degree by sampling bias and further complicated by participation bias in the response rate. Second, our study did not include people younger than 45 years of age; however, the prevalence of IVCD in younger people should be fairly low, in our opinion.

Conclusion

This study provided reliable prevalences for LBBB, RBBB, bifascicular block and NS-IVCD in Chinese adults. This study also identified the factors that are independently associated with LBBB, RBBB and NS-IVCD in Chinese adults.

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Data availability statement

The data analysed in this study are available upon reasonable request.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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Author Contributions

QQ, JL, NC, XD, RB, JDong and CM designed the study and were responsible for the data collection. QQ, SX and JDu performed the statistical analyses. QQ, JL and NC prepared the manuscript. All authors contributed to reviewing or revising the manuscript and approved the final version.

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Supplemental material

Supplemental material for this article is available online.

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