

SHORT REPORT

Variations in blood pressure control by medical comorbidities prior to sudden death

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Abstract

Patients with hypertension have increased risk of sudden death, but the impact of blood pressure control in sudden death is not clear. To better understand potential opportunities to prevent sudden, we assessed blood pressure control, comorbidities, and the number of recent medical encounters among all-cause sudden death victims. Less than 40% of sudden death victims with hypertension had controlled blood pressure prior to death. Furthermore, increased frequency of medical visits and number of comorbidities were associated with better blood pressure control. Strategies to address clinical inertia in hypertension treatment particularly for patients with fewer comorbidities may attenuate the risk of sudden death.

1 | BACKGROUND

Sudden death is estimated to cause 180 000–450 000 deaths per year in the United States, and its incidence has not declined despite recent improvements in cardiovascular mortality.¹ Patients with hypertension (HTN) have increased risk of sudden death.²

Hypertension is associated with a twofold increased risk for sudden cardiac death with a 28% increase in risk per 20 mm HG increase in systolic blood pressure (SBP).³

The 2017 American College of Cardiology (ACC) and American Heart Association (AHA) hypertension guidelines include specific recommendations for hypertension (HTN) treatment in the setting

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of various medical comorbidities.⁴ However, clinical practice guidelines are often underutilized, and the adherence to these guidelines in the setting of specific comorbidities has not been reported.⁵ Use of antihypertensive drug therapy among individuals with hypertension has not been shown to reduce sudden death; however, these studies have not distinguished whether antihypertensive drug therapy has achieved guideline-adherent blood pressure (BP) control.⁶ Further, prior research has found that only 41.5% of sudden death victims are prescribed any antihypertensive medication.⁷ This study aimed to better understand current practices of BP control among all-cause sudden death victims with various comorbidities in order to identify potential opportunities to prevent sudden death.

2 | METHODS

Cases of out-of-hospital sudden death were prospectively identified by screening all deaths aged 18–64 in Wake County, NC from 2013 to 2015 attended by Emergency Medical Services (EMS).

Detailed screening and adjudication methods have been previously described.⁸ Sudden death in our study included all types of sudden death not attributed to trauma, suicide, or natural expected death. Accordingly, person with terminal disease, evidence of overdose, or other obvious non-natural cause (eg, trauma, violent death, and drowning) were excluded. Additionally, persons not community-dwelling (eg, primary residence was in a skilled nursing facility or correctional facility) were excluded. This study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

Of the identified 399 sudden death victims, patients without HTN, without medical records, or with history of congestive heart failure and chronic kidney disease were excluded from this analysis. The number of outpatient clinic visits and the 10 most recent BP measurements from outpatient encounters within two years preceding death were included in the analysis. Goal BP control was defined by an average SBP below 130 mm Hg per the 2017 ACC/AHA hypertension guidelines.⁴ Covariates included sociodemographic factors and clinical comorbidities including coronary artery disease (CAD), diabetes mellitus (DM), chronic respiratory disease (CRD), and mental illness (including depression, anxiety, bipolar, psychotic, substance use, and alcohol use disorders).

Demographic and clinical covariates were summarized using frequencies for categorical variables and means with standard deviations (SD) for continuous variables. The mean SBP, mean diastolic BP (DBP), and the proportion of patients with goal BP attainment were calculated for all sudden death victims, for victims with each individual clinical comorbidity, as well as for victims with 0, 1, 2, and 3+ comorbidities. Outcomes were compared between groups using univariate analysis of variance (ANOVA). Statistical analyses were performed using SAS version 9.3 (SAS institute Inc).

3 | RESULTS

Of the 399 sudden death victims, 144 had available medical records of which 91 (63.2%) had a diagnosis of HTN. The average age of the 91 victims with HTN was 54.2 years, 36.3% were female, 68.1% were white, and 30.8% were African American. CAD was present in 15.4% of victims, DM in 37.4%, CRD in 40.7%, and mental illness in 59.3%.

BP control had been attained in 36.7% of victims. The average number of clinic visits, average SBP and DBP, and proportion of victims with BP control are reported by each individual comorbidity and by total number of comorbidities in Table 1. Presence of CAD and CRD was associated with better BP control ($p = .008$ and $p = .003$, respectively). Among victims with 0, 1, 2, or 3+ comorbidities, BP goal was attained in 30.4%, 24.2%, 35.6%, and 59.9%, respectively. Presence of 3+ comorbidities was associated with significantly improved BP control ($p < .001$). The average number of clinic visits within the two years preceding death was 6.5. Increasing number of comorbidities was associated with increased average number of clinic visits within the prior two years, with victims with 0, 1, 2, and 3+ comorbidities having 4.0, 5.5, 7.5, and 8.7 average clinic visits, respectively. Even after adjustment for the number of medical visits, increased number of comorbidities was associated with better BP control.

4 | DISCUSSION

Among sudden death victims with hypertension, 63.7% had not achieved BP control despite 6.5 average clinic visits in the two years preceding death. Comorbid CAD or CRD were associated with significantly improved BP control. Furthermore, presence of 3 or more comorbidities was associated with improved BP control (59.9%) compared with 0, 1, or 2 comorbidities (30.4%, 24.2%, or 35.6%, respectively), even after controlling for the number of clinic visits. Increased number of clinic visits alone do not correlate with improved BP control. These findings suggest that presence of 3 or more comorbidities and the diagnosis of CAD or CRD promote increased vigilance and more aggressive therapeutic decisions by physicians during medical encounters. Strategies to overcome clinical inertia in HTN management, particularly among patients with fewer comorbidities, may improve BP control and attenuate the risk of sudden death.

Study limitations include that two-thirds of sudden death victims were precluded from analysis due to absence of available medical records, which may have excluded patients with HTN but with limited healthcare contact. While use of real-world evidence advantageously provides information about real-world clinical practices, it also has certain limitations including that the appropriateness of BP measurement techniques and the prevalence of white coat hypertension are unknown and could have introduced measurement bias. Furthermore, medication adherence was unknown, and nonadherence could impact BP control. Our study cannot identify a causal relationship between improved BP control and prevention of sudden death. Further studies are needed to clarify the relationship between BP control and sudden death prevention.

TABLE 1 Average blood pressures and achievement of goal blood pressure by individual comorbidities and by number of comorbidities

Comorbidities	Cases, n	Average number of clinic visits ¹	Systolic BP, mean (SD)	Diastolic BP, mean (SD)	Proportion at BP goal (%)	Proportion at BP goal p-value
Clinical comorbidities						
Coronary artery disease	14	6.2	127.8 (17.0)	79.7 (13.2)	55.3	.008
No coronary artery disease	77	6.3	139.9 (17.1)	84.7 (10.7)	30.8	
Diabetes mellitus	34	7.6	137.6 (14.2)	82.3 (11.4)	35.8	.379
No diabetes mellitus	57	5.5	138.4 (19.4)	84.9 (11.0)	33.8	
Chronic respiratory disease	37	7.7	132.0 (15.2)	79.8 (10.1)	46.5	.003
No chronic respiratory disease	54	5.3	142.3 (18.1)	86.8 (11.5)	26.4	
Mental illness	54	7.2	138.2 (18.4)	83.4 (10.5)	37.4	.354
No mental illness	37	5.3	137.7 (15.2)	85.0 (11.6)	32.3	
Number of additional comorbidities						
0 comorbidity	15	4.0	136.2 (14.7)	84.3 (8.5)	30.4	.495
1 comorbidity	32	5.5	145.4 (17.9)	89.1 (11.8)	24.2	Ref
2 comorbidities	28	7.5	137.5 (16.7)	83.2 (8.7)	35.6	.130
3 + comorbidities	16	8.7	126.5 (9.6)	75.6 (8.9)	59.9	<.001
Total	91	6.5	138.1 (17.1)	84.1 (11.0)	35.0	

^aClinic visits within the 2 years preceding death.

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CONFLICT OF INTERESTS

Ross J. Simpson, Jr has served as consultant for Amgen, Merck, Pfizer, CEROBS and ISS. He is currently the UNC site Principal Investigator for an Amgen sponsored observational research project. All remaining authors declare that they do not have a conflict of interest.

AUTHOR CONTRIBUTIONS

RS and AC conceived and designed the study. AC, SG, and FL analyzed the data. SK, AC, and RS interpreted results. SK and AC drafted the manuscript. SG, FL, and RS edited and revised the manuscript. SK, AC, SG, FL, and RS approved the final version of the manuscript.

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