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## CASE REPORT

### Impact of Climate Change on Management of Systemic Hypertension in North-Eastern Nigeria

#### *Impact du Changement Climatique sur la Gestion de l'Hypertension Systémique dans le Nord-Est du Nigeria*

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#### ABSTRACT

The impact of climate change on health, including changes in epidemiology and heat-related complications, has been variously reported in many parts of the world. Maiduguri, the capital of Borno state in north-eastern Nigeria, has been bearing the brunt of increasing temperatures over the past years, especially during the early months of the year building up to the commencement of the rainy season; with an average daily temperature forecasted to be around 40°C. Patients with systemic hypertension and other forms of cardiovascular diseases are vulnerable to heat-related complications including dehydration, hypotension, and orthostatic hypotension (OH). This is particularly true in patients receiving various forms of antihypertensive medication, including diuretics. We present three cases of symptomatic OH occurring during the peak of heat season in Maiduguri among patients receiving various combinations of antihypertensive medication. **WAJM 2022; 39(10): 1104–1107.**

**Keywords:** Climate change, Hypertension, Antihypertensive agents, Orthostatic hypotension, Semi-arid zone, Maiduguri, Nigeria.

#### RÉSUMÉ

L'impact du changement climatique sur la santé, y compris les changements dans l'épidémiologie et les complications liées à la chaleur, a été diversement rapporté dans de nombreuses régions du monde. Maiduguri, la capitale de l'État de Borno, dans le nord-est du Nigeria, a subi de plein fouet l'augmentation des températures au cours des dernières années, en particulier au cours des premiers mois de l'année, jusqu'au début de la saison des pluies. Les patients souffrant d'hypertension systémique et d'autres formes de maladies cardiovasculaires sont vulnérables aux complications liées à la chaleur, notamment la déshydratation, l'hypotension et l'hypotension orthostatique (OH). Cela est particulièrement vrai chez les patients recevant diverses formes de médicaments antihypertenseurs, notamment des diurétiques. Nous présentons trois cas d'OH symptomatique survenus pendant le pic de la saison chaude à Maiduguri chez des patients recevant diverses combinaisons de médicaments antihypertenseurs. **WAJM 2022; 39(10): 1104–1107.**

**Mots clés:** Changement climatique, Hypertension, Agents antihypertenseurs, Hypotension orthostatique, Zone semi-aride, Maiduguri, Nigeria.

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## INTRODUCTION

The impact of climate change on health and clinical practice has been a subject of interest and is increasingly becoming so in tandem with the escalating concern on global warming.<sup>1</sup> The impact of heat is particularly more devastating in areas with hot, semi-arid climates located between latitudes 20° and 30° (bordering the tropical savanna climate) involving parts of Africa, Australia, and South Asia.<sup>2</sup> Based on WHO estimates, 92,000 deaths will occur annually from heat waves in 2030, mostly in sub-Saharan Africa, Latin America, and South-East Asia.<sup>3</sup> Maiduguri, the capital of Borno State, is located at latitude 11°51'N and longitude 013°05'E in northeastern Nigeria.<sup>2</sup>

Hot weather has increasingly become a concern in Maiduguri over the years, bringing untold hardship to the populace. On May 28, 1983 a scorching temperature of 47°C was recorded and in 2002, the intense heat resulted in the death of 60 people from heat stroke and other heat-related illnesses in a one week.<sup>4</sup> An average temperature of 37.8°C, 40.1°C and 39.4°C are usually recorded in the months of March, April, and May respectively.<sup>2</sup>

Of all environmental causes of death in Northern Australia (a region that shares common climatic condition with Maiduguri) between 2003 and 2018, heat-related causes accounted for 22%, and most occurred when the heat was at its peak in January.<sup>5</sup> About 50% of those that succumbed to the heat had co-morbid conditions including hypertension, coronary artery disease and diabetes mellitus, among others.<sup>5</sup> There are limited studies on the health impact of heatwaves in SSA.<sup>6</sup> A study in Burkina Faso (similar climatic conditions with Maiduguri) revealed seasonal increase in cardiovascular death during the months of March-May, corresponding to periods with the peak temperatures.<sup>7</sup>

Chronic medical conditions including cardiovascular diseases and medications predispose to heat-related illnesses or complications, especially in the elderly. In one study, individuals with systemic hypertension were found to have increased sweat evaporation on

recovering from moderate-intensity exercise, a process that could result in loss of more water and dehydration.<sup>8</sup> Drugs used in the treatment of systemic hypertension and other cardiovascular conditions (ischemic heart disease, heart failure, etc.) could accentuate the risks of heat-related complications. Hypovolemia and OH could result from use of beta blockers, diuretics, calcium channel blockers (CCB) and angiotensin converting enzyme (ACE) inhibitors / angiotensin receptor blockers (ARB), increasing the risk of syncope and falls.<sup>9</sup> These concerns have been recently highlighted in the Consensus statement by the European Society of Hypertension working group on blood pressure monitoring and cardiovascular variability.<sup>10</sup>

We herein report three cases of OH during the peak heat period in patients receiving antihypertensive medications in the semi-arid town of Maiduguri in northeastern Nigeria.

## CASE REPORTS

### Case 1

A 49-year-old housewife receiving care for systemic hypertension for 8 years complained of dizziness on assuming standing position in April 2018. This was associated with fatigue, shortness of breath, neck, and shoulder pains. She also noticed new onset bilateral pedal swelling. There was no history of chest pain, palpitation, or syncope. She had been on 10mg of amlodipine, 50mg of atenolol and 50mg of losartan. Her supine blood pressure was 111/78mmHg, which dropped to 90/62 mmHg with the pulse rising from 94 bpm to 108bpm after three minutes of standing upright. A diagnosis of OH was made. Losartan and amlodipine were stopped, and atenolol reduced to 25mg a day. She was advised to avoid the heat, ensure adequate hydration, and advised on home blood pressure monitoring (HBPM). The orthostatic symptoms resolved, and she returned in June 2018 when she noticed a rise in her blood pressure. Her medication was gradually restarted and titrated back to previous regimen. She continued HBPM and remained asymptomatic.

### Case 2

A 52-year-old housewife receiving care for systemic hypertension for 11 years complained of worsening fatigue, dizziness, and palpitation in May 2018. She noticed bilateral pedal swelling, especially after assuming the standing position and walking some distance. She had elevated total and LDL cholesterol and was recently reviewed by the gynecologist for climacteric symptoms. Other biochemical parameters including thyroid function test were within normal limits. She was on amlodipine 10mg, Lisinopril 10mg and Rosuvastatin 10mg. Her blood pressure was 114/86mmHg in supine position and dropped to 84/70 mmHg with a pulse of 116 after three minutes of standing. Lisinopril and amlodipine were stopped. Her symptoms resolved and she remained off antihypertensive medication while monitoring blood pressure at home. She was closely followed up and medications were gradually restarted two months later when blood pressure on HBPM was noticed to be increasing. She remained asymptomatic.

### Case 3

A 76-year-old businessman receiving care for systemic hypertension, diabetes mellitus and dyslipidemia complained of dizziness on assuming the erect posture especially while praying. He was diagnosed hypertensive and diabetic 30 years and 24 years ago, respectively. He reported two episodes of near syncope, necessitating prompt assumption of the sitting position. He also complained of bilateral leg swelling, especially on prolonged standing. There were no other cardio-respiratory symptoms or features of diabetic neuropathy. He has been regular with amlodipine 10mg, valsartan 160mg, vildagliptin 50mg / metformin 1000mg, atorvastatin 20mg and clopidogrel 75mg. He was diagnosed with stage 3b chronic kidney disease a few weeks prior to onset of his presenting symptoms. Supine blood pressure was 118/88 mmHg with a pulse rate of 86 bpm. The blood pressure dropped to 90/72mmHg on three minutes of standing with a pulse of 102 beats per minute. Echocardiography showed features of diastolic dysfunction, with left

ventricular ejection fraction of 60–65% by visual estimate, and 66% using Simpson's Biplane method. Amlodipine was stopped and valsartan reduced to 80mg. His symptoms improved and he continued HMBP. His medication was gradually adjusted to optimum blood pressure control over three months.

## DISCUSSION

These cases illustrate the occurrence of symptomatic OH as a heat-related complication in patients taking antihypertensive medication. In its classic form, OH is defined as persistent reduction in systolic blood pressure of 20mm Hg or greater and/or diastolic blood pressure of 10 mmHg or greater within 30 to 180 seconds of assuming an upright position, or during head-up tilt table test of at least 60°. <sup>11</sup> All three patients in this series had symptomatic OH that improved on withdrawal of antihypertensive medications.

The link between OH and antihypertensive medications remains largely conjectural, with many studies showing inconsistent results. <sup>12,13</sup> In an Irish cohort of patients on single antihypertensive medication, beta blockers resulted in increased odds of developing initial and sustained OH. <sup>14</sup> In a more recent study, metoprolol was associated with significant OH. <sup>15</sup> Beta blockers attenuate the sympathetically mediated compensatory increase in heart rate, stroke volume and peripheral vascular resistance in countering gravity-induced pooling of blood and reduced blood pressure. <sup>9,16</sup> In the ALLHAT study, recurring short-term association was observed between amlodipine use and falls between 3–6 months of randomization. <sup>17</sup> It will be interesting to determine if these falls/OH were seasonal and related to climatic conditions.

Calcium channel blockers preferentially dilate the arterioles and precapillary circulation without commensurate dilatation of the venous and postcapillary circulation. <sup>18</sup> The resulting discrepancy in resistance across the vascular beds favors transudation of plasma from the vascular space to the interstitium giving rise to edema, <sup>18</sup> a common side effect of CCB. This dose- and duration-dependent

edema commonly involves the lower limbs, and less frequently, the upper limbs. It is important to note that CCB-associated peripheral edema can be accentuated by heat edema. Two of the patients on amlodipine reported seasonal recurrence of leg swelling; this is not an uncommon cause of prescribing cascade. A case of fall and fracture has been reported following prescription of diuretics for CCB-edema. <sup>19</sup>

Symptoms of OH include dizziness, lightheadedness, visual disturbances, presyncope and syncope. Other features include shortness of breath, chest pain, neck/shoulder pain, headache, difficulty in concentrating and confusion. All three patients in this report presented with postural dizziness, lightheadedness, and profound weakness. The symptoms are chiefly driven by cerebral hypoperfusion, orthodeoxia (defective ventilation-perfusion at lung apices) and ischaemia of trapezius and shoulder girdle muscles, among others. Increased peripheral vasodilation from excess heat and pooling of blood in the venous system of the lower extremity on assuming upright position often exacerbates symptoms of OH. <sup>20</sup>

Other considerations in patients presenting with OH are neurogenic OH, including synucleinopathies and secondary autonomic neuropathies (diabetes mellitus, amyloidosis, chemotherapy, etc.). <sup>20</sup> Additional diagnostic modalities that may be required include ambulatory ECG, tilt table test, Valsalva, Quantitative Sudomotor Axon Reflex Test (QSART), among others. We did not deem it necessary to pursue these because the overall clinical context in our patients did not suggest neurogenic OH. The diabetic patient in our series did not present with overt features of autonomic dysfunction. Although presence of subclinical diabetic autonomic dysfunction may plausibly be accentuated by heat and potentiate OH, the absence of other symptoms of autonomic neuropathy and adequate compensatory increase in pulse of >15 beats on standing fairly excludes neurogenic OH. <sup>21</sup>

Orthostatic hypotension resulting from antihypertensive medication responds to reduction in dose or suspension of culprit drugs. <sup>10</sup> Two of the

patients in our series had their medication completely withheld and followed-up with HBPM, with gradual commencement outside the intense heat period. Decreased perception of thirst is common in the elderly and as such they should be encouraged to take liberal amounts of fluid regularly, even if they do not feel thirsty. A common practice in the management of systemic hypertension is dietary salt and fluid restriction (especially in patients with heart/renal failure). This, if stringent and not contextualized, could exacerbate dehydration and hypovolemia. A balance should be maintained between fluid/salt intake and the risk of volume overload in patients with heart and renal failure, and the elderly.

Measures to prevent OH include close monitoring with a view to adjusting medication, especially during the vulnerable period. The recommendations by Rene Salas and WHO comes in handy. <sup>3,22</sup> Home blood pressure monitoring should be encouraged for all patients receiving antihypertensive medications. Clinic visits for follow up should be made more frequent, building up to, and during the peak of the heat. Orthostatic hypotension should be routinely assessed especially in the elderly and those with diabetes mellitus for prompt recognition and intervention. Individualizing the dosing plan for diuretics will be helpful, especially in enlightened patients without cognitive dysfunction.

Concerted efforts on enlightenment on the health impact of heatwaves will go a long way in ameliorating the problems. WHO has published a position document on general measures required to mitigate the impact of heatwaves. <sup>3</sup> Actions required to manage and prevent the impact of extreme heat through the development of national and subnational action plans, remains largely absent in most vulnerable countries of sub-Saharan Africa. Attention should be given to weather forecast to proactively anticipate heat-related complications and timeously enlighten the populace. In particular, patients on medications for various cardiovascular disorders, and especially those on antihypertensive should be educated on the dangers of heatwave, dehydration and hypovolemia.

Despite being a seasonal occurrence in Maiduguri, heat-related complications are not commonly factored in the day-to-day care of patients with systemic hypertension and other cardiovascular diseases. Global warming / climate change is taking its toll, and heat-related complications are on the increase. Going by the available data, this is only going to worsen. Concerted efforts are required to enlighten healthcare workers and the public to ameliorate, if not completely stem the tide. A stitch in time saves nine.

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#### Competing Interests

None to declare.

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