REVIEW ARTICLE

A Multispecialty Consensus on Individualized Treatment Strategies for Hypertension Phenotypes and Comorbidities

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Abstract

Hypertension (HTN) remains a leading contributor to global morbidity and mortality, often coexisting with major comorbidities such as diabetes, chronic kidney disease (CKD), coronary artery disease (CAD), heart failure (HF), and obesity. In India, a significant proportion of hypertensive individuals remain undiagnosed or inadequately treated. This multispecialty consensus provides comprehensive, evidence-based recommendations for individualized HTN management tailored to specific phenotypes and comorbidities. Developed through structured expert panel discussions and a review of international and national guidelines, the consensus emphasizes out-of-office blood pressure (BP) monitoring, phenotype recognition (e.g., white-coat, masked, nocturnal HTN), and early detection of target organ damage. The document outlines practical algorithms and a therapeutic wheel to guide antihypertensive therapy based on patient-specific factors, promoting use of angiotensin-converting enzyme inhibitors (ACEI), angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs), beta-blockers (BB), and diuretics, as per clinical context. Special considerations are provided for managing HTN in young adults, patients with tachycardia, stroke, and respiratory disorders. The consensus also advocates for lifestyle modifications, treatment adherence, and multidisciplinary care to improve BP control and long-term outcomes. By promoting a holistic, patient-centered approach, this consensus aims to bridge gaps in clinical practice and standardize the management of HTN in diverse healthcare settings.

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Introduction

Noncommunicable diseases, including hypertension (HTN), are highly prevalent in developed and developing countries worldwide. HTN is emerging as a serious threat to public health, as it is a chief causative factor responsible for global deaths from stroke to coronary heart disease.[1] In India, HTN is the leading risk factor for death and disability, with prevalence rates of 24% in men and 21% in women, as reported by the 2019–2020 National Family Health Survey (NFHS-5).[2] The recently published ICMR-INDIAB study involved a total of 1,13,043 participants, with 79,506 individuals from rural areas and 33,537 from urban areas, reporting a 35.5% prevalence of HTN, with higher rates in urban areas compared to rural ones. A significant number of existing HTN cases in India, close to 58%, are undiagnosed as per the recent data from NFHS. Undiagnosed HTN is a significant concern, particularly in rural areas, highlighting the necessity for accurate measurements and awareness campaigns.[3]

Hypertension is invariably diagnosed along with multiple comorbidities, particularly type 2 diabetes mellitus (T2DM), obesity, chronic kidney disease (CKD), coronary artery disease (CAD), and heart failure (HF).[4] Recognizing and managing these risk factors and target organ effects is crucial for effectively treating hypertensive patients. As individuals in these high-risk groups are more prone to target organ

damage, clinical guidelines recommend stricter blood pressure (BP) control targets.[5] Despite advancements in BP measurement methods and the availability of effective and safe antihypertensive medications, these resources are not always utilized to their full potential in clinical practice. As a result, a considerable number of patients on antihypertensive treatment do not achieve adequate BP control. This leads to a higher risk of HTN-related cardiovascular (CV) complications, contributing to increased morbidity and mortality.[6]

The aim of this consensus paper is to provide comprehensive guidance on the management of HTN and its associated comorbidities, with a focus on personalized, patient-centered care. The paper emphasizes the importance of phenotype-specific strategies in managing HTN. A key feature of this consensus is the proposal of a therapeutic wheel, designed to guide clinicians in selecting appropriate treatment strategies based on individual patient profiles and comorbid conditions. By increasing awareness among healthcare providers and advocating for the holistic management of comorbidities, this consensus seeks to optimize BP control, minimize HTN-related complications, and enhance overall patient well-being.

Need for Consensus

The growing prevalence of HTN and its associated comorbidities necessitates a unified approach to management. HTN is a leading modifiable risk factor for numerous CV and renal diseases. However, its management is complicated by diverse phenotypes such as sustained normotension, masked HTN, and nocturnal HTN, as well as the frequent coexistence of comorbidities like diabetes, dyslipidemia, and obesity. These comorbidities often remain undiagnosed, delaying effective intervention. A "one-size-fits-all" approach to HTN is inadequate, as treatment based solely on BP levels overlooks the broader clinical picture, patient-specific factors, and diverse population needs.

To improve outcomes, HTN management must adopt a holistic, patient-centered approach. This includes early detection of comorbidities, personalized therapy that accounts for individual differences, and collaborative care involving multidisciplinary teams. Routine screenings, evidence-based guidelines, and phenotype-specific strategies, such as monitoring out-of-office BP, are essential. A consensus on individualized management strategies for HTN, its phenotypes, and associated comorbidities is essential to ensure consistent, evidence-based care across diverse healthcare settings. A standardized approach helps prevent fragmented care, improves outcomes, and promotes collaboration among specialists, ensuring comprehensive management.

Methodology

A comprehensive review of national and international HTN management guidelines was conducted to incorporate the latest evidence-based practices. An expert panel comprising cardiologists, endocrinologists, nephrologists, and primary care physicians was convened to discuss and deliberate on key issues, including diagnostic challenges, phenotype-specific strategies, and holistic management approaches. Multiple rounds of structured discussions were held to address the limitations of existing practices and to identify areas requiring consensus. The panel's insights were synthesized to formulate practical, patient-centered recommendations aimed at improving management of HTN and its associated comorbidities.

Results

Ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM) are both valuable tools for managing HTN. ABPM provides a comprehensive 24-hour BP profile, capturing variations throughout the day and night, including nocturnal HTN, which is a strong predictor of CV risk. HBPM, on the contrary, offers a practical and cost-effective alternative, allowing patients to monitor their BP regularly at home, leading to better long-term management and adherence to treatment (Table 1).

Clinical Characteristics—Phenotypes

Advances in out-of-office BP monitoring have led to the identification of various BP phenotypes, each with distinct prognostic implications for long-term CV risk. Accurate diagnosis of these phenotypes requires both in-office and out-of-office BP measurements. These phenotypes are as shown in Tables 2 and 3.[7]

Out-of-office BP monitoring has identified various phenotypes, such as white-coat HTN, masked HTN, nocturnal HTN, and high BP variability, each with distinct prognostic implications for long-term CV risk.

Treatment of Uncomplicated Hypertension

For patients with uncomplicated HTN, treatment should begin with a dual combination therapy, ideally as a single-pill combination. Recommended combinations include an angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs) with a calcium channel blocker (CCB)

Table 1: Summary of recommendations of BP measurement methods and their clinical implications by Indian guidelines on HTN[14]

Method	*Cutoff for diagnosis*	*Recommendations*
Clinic (office) BP measurement	SBP: ≥140 DBP: ≥90	• Diagnosis based on multiple readings over several visits • Aneroid, large dial apparatus preferred; requires calibration every 6 months • BP cuff should cover 80% of upper arm length (standard: 12 × 35 cm)
HBPM	SBP: ≥135 DBP: ≥85	• Helps differentiate sustained vs white coat HTN • Only validated oscillometric devices (brachial artery) should be used • Finger and wrist monitors are not recommended • Recommended readings: morning and evening for 3–5 days • Average of multiple readings provides a true BP estimate • May not be accurate in atrial fibrillation or arrhythmias
ABPM	Day mean: SBP: ≥135; DBP: ≥85 Night mean: SBP: ≥120; DBP: ≥70 24h mean: SBP: ≥130; DBP: ≥80	• Detects white coat, masked, nocturnal, resistant, and episodic HTN • Identifies BP variations: dipping, nondipping, extreme dipping, and reverse dipping • Uses a portable monitor for 24–48 hours • Early morning BP surge (>3 hours) increases CV risk

ABPM, Ambulatory blood pressure monitoring; BP, blood pressure; CV, cardiovascular; HBPM, Home blood pressure monitoring; SBP, systolic blood pressure; DBP, diastolic blood pressure; HTN, hypertension

Table 2: HTN phenotypes, prognostic implications, and management strategies

Phenotype	*Description*	*Prognostic implications*	*Management*
Controlled HTN	Normal BP readings in-office and out-of-office due to antihypertensive therapy	Reduced CV risk compared to uncontrolled HTN[9]	Adherence to prescribed antihypertensive therapy; lifestyle modifications
Masked HTN	Office BP is not elevated, but the 24-hour ambulatory BP average is ≥130/80 mm Hg (or awake average is ≥135/85 mm Hg) and Home BP is >135/85[8]	Increased risk of CV events and organ damage[7]	HBPM, lifestyle changes, initiation or intensification of antihypertensive therapy
WCH/WCE	Office BP is elevated, but the Home BP is <135/85 and 24-hour ambulatory BP average is <130/80 mm Hg[8]	Lower CV risk than sustained HTN, but higher than normotension	Regular BP monitoring, lifestyle modifications, and pharmacotherapy, only if CV risk is high
Uncontrolled HTN/ sustained HTN	Persistent BP elevation in-office and out-of-office settings	• May indicate suboptimal treatment or stress-related BP elevation • Increased risk of CV disease, stroke, and mortality	• Reassess treatment adherence; consider alternative therapies or HBPM • Treatment with a 3-drug regimen: RAAS inhibitor (ACEI/ARB), long-acting CCB, and a thiazide or thiazide-like diuretic [hydrochlorothiazide (HCTZ), chlorthalidone or indapamide] • Lifestyle modifications
Nocturnal HTN	Average sleep BP ≥120/70 mm Hg	Associated with increased CV risk, target organ damage, and mortality	Antihypertensive medications such as diuretics, BBs, CCBs, ACEI, or ARBs; bedtime dosing may be beneficial
ISH[10]	SBP >140 mm Hg with DBP <90 mm Hg, commonly seen in older adults	Increased risk of CV disease, stroke, and mortality	First-line: thiazide-like diuretics or CCBs; ACEI/ARB reserved for comorbid conditions; combination therapy if SBP >160 mm Hg or >20/10 mm Hg above target. BB are less effective for stroke prevention. Secondary causes should be ruled out
IDH[11–13]	SBP <140 mm Hg with DBP >90 mm Hg. More common in younger adults	Uncertain CV risk may indicate early HTN progression	Treatment options include ACEI, thiazide diuretics, or CCBs. Lifestyle modifications are recommended

ALLHAT, antihypertensive and lipid-lowering treatment to prevent heart attack trial; IDH, isolated diastolic hypertension; ISH, isolated systolic hypertension; WCE, white coat effect; WCH, white coat hypertension

Table 3: HTN phenotypes as per Indian guidelines for HTN 2019[14]

Category	*Office BP*	*Home BP*
White coat HTN incidence: 10–15%	High	Normal
Masked HTN incidence: 5–10%	Normal	High
Sustained HTN	High	High
True normotension	Normal	Normal

or a thiazide/thiazide-like diuretic (Fig. 1). Monotherapy may be reserved for specific cases, such as low-risk grade 1 HTN, very elderly individuals, or frail patients. If BP remains uncontrolled, escalation to a triple combination of an ACEI/ARB + CCB + diuretic is advised. In cases of resistant HTN, adding a fourth drug such as spironolactone, another diuretic, alpha (α)-blocker, or beta-blocker (BB) is recommended. Referral to a specialist should be considered if adequate control is not achieved.

Comorbidities Associated with Hypertension and Evidence-based Approaches

Hypertension and Diabetes

Hypertension and T2DM frequently coexist as comorbid conditions. Patients with HTN often show insulin resistance and have a higher likelihood of developing diabetes than those with normal BP.[15] In a study by Geldsetzer et al., the crude prevalence of diabetes was reported at 7.5%, while that of HTN was 25.3%.[16] In India, the coexistence of diabetes and HTN is a growing trend, with individuals with diabetes having a 1.5–2 times higher prevalence of HTN compared to those without diabetes.[17] In a retrospective study of 2,672 patients conducted in an Indian state (Haryana), 11.83% of patients with essential HTN had new-onset diabetes.[18] HTN in diabetes results from fluid overload and vascular remodeling driven by insulin resistance, hyperinsulinemia, and hyperglycemia. Early-stage diabetes leads to HTN due to fluid retention, while later stages see increased vascular resistance.[19] The main goal of treatment focuses on achieving the target BP (Fig. 2).

Hypertension and Chronic Kidney Disease

Chronic kidney disease and end-stage kidney disease (ESKD) are increasingly common due to the growing prevalence of noncommunicable diseases like T2DM and HTN. The bidirectional relationship between HTN and CKD not only contributes to kidney damage but also accelerates the decline of renal function in diabetic patients. T2DM and HTN are responsible for close to half of all cases of CKD in India.[20] As per a narrative review of Asian populations, the overall prevalence of CKD was 17.2%, whereas HTN was present in 43.1% of the participants. ESRD due to HTN was reported to be 12.8%.[21] The Indian Chronic Kidney Disease (ICKD) study reports the prevalence of HTN to be 87% in CKD patients.[22] Management is decided based on the CKD stage (Fig. 3).

Hypertension and Coronary Artery Disease

Hypertension is a significant risk factor for CAD, as it accelerates coronary atherosclerosis and contributes to narrowing of the coronary arteries. Elevated systolic blood pressure (SBP) is particularly linked to complications such as ischemia, cardiac hypertrophy, and myocardial fibrosis. The frequent coexistence of HTN and CAD arises from overlapping risk factors and shared pathophysiological mechanisms. Patients with both conditions typically experience worse clinical outcomes and prognosis compared to those with either condition alone, emphasizing the need for effective management strategies for both conditions together (Fig. 4). About 50–60% of individuals with CAD also have HTN, while approximately 13% of those with HTN have CAD.[23]

Hypertension and Heart Failure

Hypertension is a major and prevalent risk factor for the development of HF across all levels of left ventricular ejection fraction (LVEF), particularly playing a key role in HF with preserved ejection fraction (HFpEF).[24] In

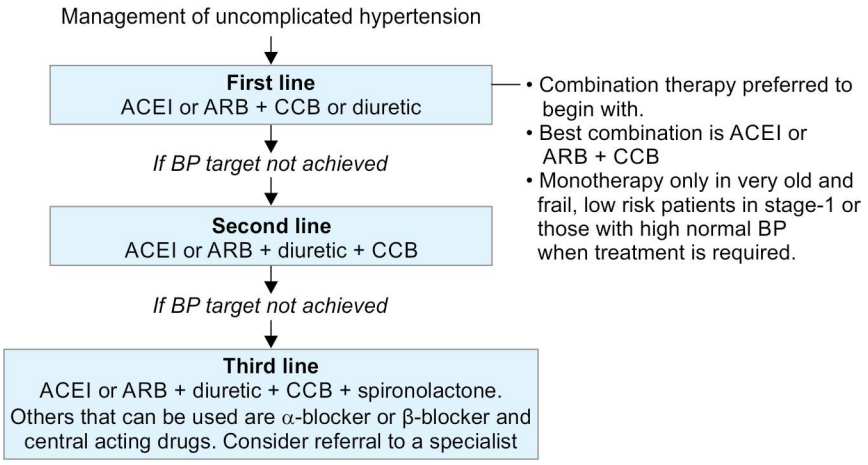


Fig. 1: Treatment of uncomplicated HTN

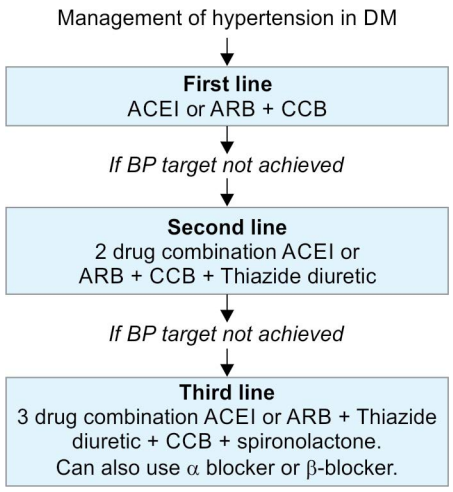


Fig. 2: HTN treatment algorithm in diabetic patients

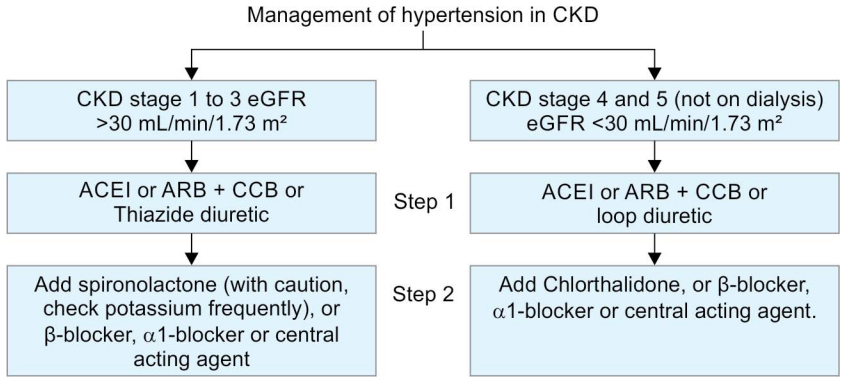


Fig. 3: Algorithm for HTN in CKD; eGFR, estimated glomerular filtration rate

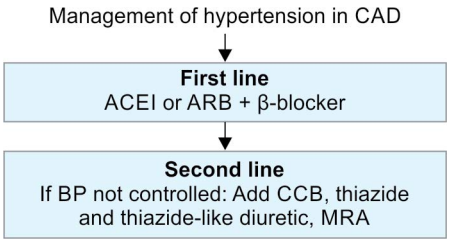


Fig. 4: Antihypertensive therapy selection in patients with CAD

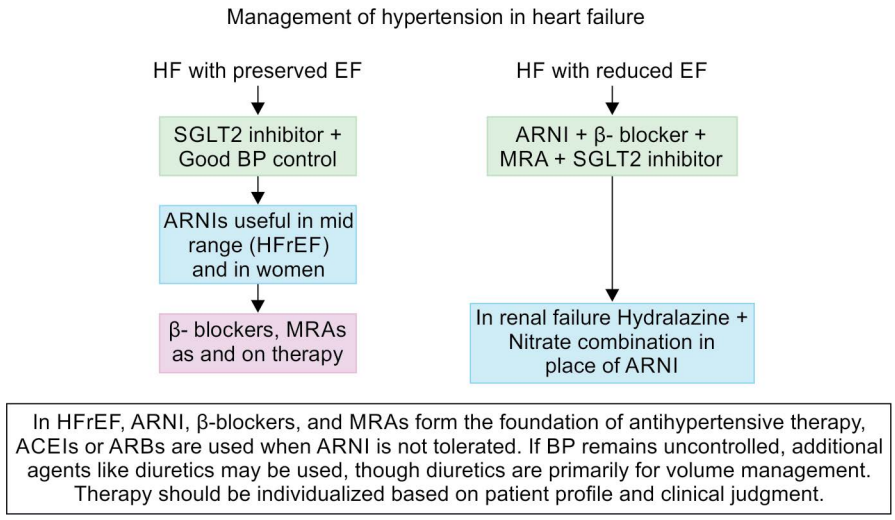


Fig. 5: Antihypertensive strategy in patients with HF

the Framingham Heart Study cohort, 91% of individuals diagnosed with HF had a prior history of HTN, emphasizing the strong connection between the two conditions.[25,26] Several clinical trials have evaluated various therapies in HF. The CONSENSUS study showed that enalapril significantly reduced 1-year mortality by 31% in severe HF patients.[27] Other studies reported improved BP control and outcomes with angiotensin receptor neprilysin inhibitor (ARNI), eplerenone, finerenone, and loop diuretics, particularly in resistant or mineralocorticoid receptor antagonist (MRA)-resistant HTN and older HF patients (Fig. 5).[28–31]

Hypertension and Dyslipidaemia

Hypertension and dyslipidemia are major CV risk factors that often coexist. Population studies show a correlation between rising BP levels and increased lipid levels, likely driven by shared mechanisms like obesity-induced adipocytokine dysregulation. Dyslipidemia impairs arterial function, promotes atherosclerosis, and disrupts BP regulation, increasing the risk of HTN.[32] Epidemiological studies indicate that HTN and dyslipidemia coexist in 15–31% of cases, with up to 40% of newly diagnosed hypertensive individuals having at least one lipid abnormality.[33] Management depends on the effect the drugs have on the lipid profile (Fig. 6).

Hypertension and obesity

Obesity-related HTN is a complex condition influenced by multiple genetic and physiological factors. Key contributors include hyperinsulinemia, activation of the renin-angiotensin-aldosterone system (RAAS), heightened sympathetic activity, and imbalances in adipokines like leptin or endothelial-targeting cytokines.[34] Population-based studies suggest that obesity may contribute to approximately 75% of HTN cases.[35] Management of HTN in obesity, with tailored approaches for patients with or without metabolic syndrome (Fig. 7)

Hypertension and Tachycardia

Tachycardia is linked to an increased risk of HTN and greater CV morbidity and mortality.[36] Tachycardia [heart rate (HR) ≥ 100 bpm][37]

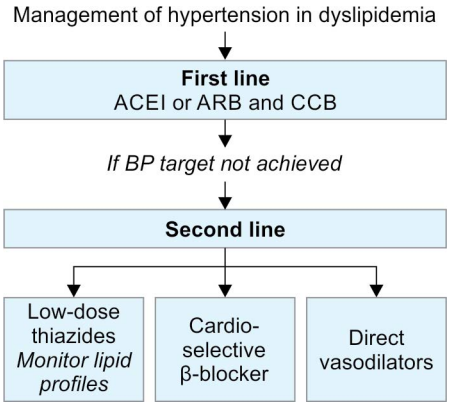


Fig. 6: Antihypertensive therapy in patients with dyslipidaemia

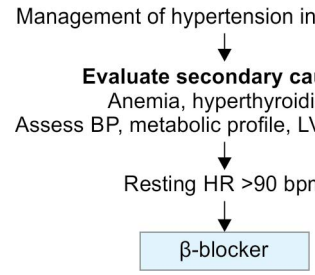


Fig. 8: Treatment approach for HTN in tachycardic patients; DHP, dihydropyridine; LVH, left ventricular hypertrophy

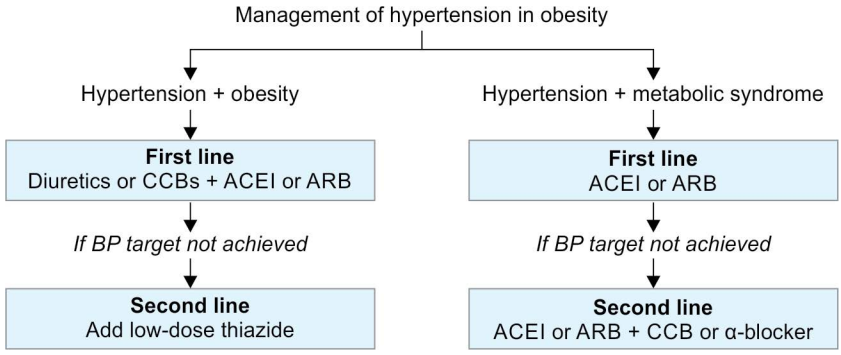


Fig. 7: Antihypertensive management in obesity and metabolic syndrome; GLP-1RA, glucagon-like peptide-1 receptor agonist; RAS inhibitors; renin-angiotensin system inhibitors

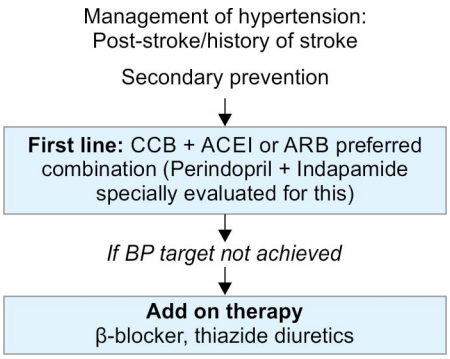


Fig. 9: Treatment of HTN following stroke

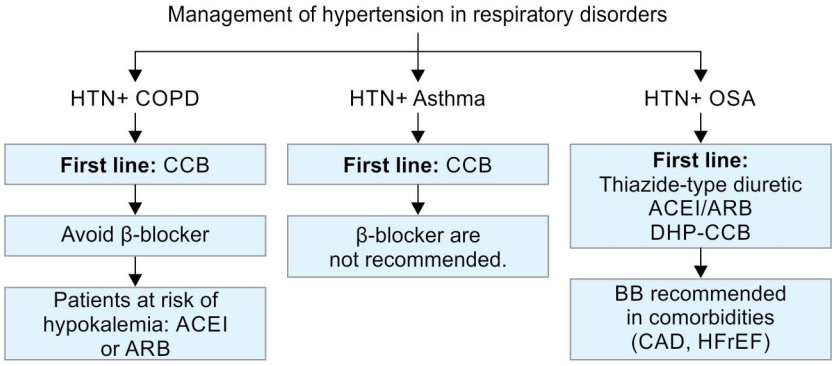


Fig. 10: Antihypertensive management in patients with coexisting respiratory disorders; ADR, adverse drug reactions; DPAH, drug-induced pulmonary arterial hypertension; HFrEF, heart failure with reduced ejection fraction; HPAH, heritable pulmonary arterial hypertension; IPAH, idiopathic pulmonary arterial hypertension; mPAP, mean pulmonary arterial pressure; PVR, pulmonary vascular resistance

is observed in over 30% of hypertensive patients.[38] Studies indicate a 3–4 times higher risk of developing HTN with an elevated HR, even after adjusting for traditional risk factors. Furthermore, the rising HR in hypertensive patients correlates with worse CV outcomes. Therefore, managing elevated HR is essential in HTN treatment.[39] Masked tachycardia, affecting up to 10% of hypertensive individuals, is significant because it often goes undetected during routine examinations. Despite this, it poses a heightened risk of target organ damage and CV events, underscoring the need for vigilant diagnosis and management.[40] The link between high HR and CV disease is due to a heightened sympathetic activity. Management strategy for HTN with tachycardia, recommending BBs when resting HR exceeds 90 bpm after ruling out secondary causes (Fig. 8).

Hypertension and Stroke

Stroke is a significant global health issue, being the second leading cause of death and long-term disability. It has accounted for approximately 5.7 million deaths, with the majority occurring in low- and middle-income countries. While 85% of strokes are ischemic, 15% are hemorrhagic. The incidence of stroke has risen in South Asian countries, while it has decreased in European nations. The South Asian population is at higher risk due to factors like HTN, DM, smoking, and family history.[41] In a hospital-based retrospective study conducted by Misgana et al., out of 583 hypertensive patients, 106 (18.18%) developed a stroke.[42] In India, HTN accounts for 57% of all stroke-related deaths.[43]

A combination of perindopril with indapamide and other intensive combination regimens has shown greater benefit in reducing recurrent stroke and cerebrovascular events.[44–46]

Telmisartan, an ARB, has been investigated for its role in secondary stroke prevention due to its antihypertensive and vascular protective properties. In a large multicenter trial involving patients aged ≥55 years with a recent ischemic stroke, telmisartan was compared to placebo for secondary stroke prevention in over 10,000 participants. Treatment with telmisartan led to a modest reduction in BP of 3.8/2.0 mm Hg compared to placebo[47] (Fig. 9).

Hypertension and Pulmonary Disorders

According to the World Health Organization (WHO), asthma impacted approximately 262 million individuals worldwide in 2019 and was responsible for around 4,55,000 deaths that year.[48] Chronic obstructive pulmonary disease (COPD) ranked as the fourth leading cause of death globally in 2021, accounting for an estimated 3.5 million deaths, which represents about 5% of all deaths worldwide.[49] Obstructive sleep apnea (OSA), the most prevalent form of sleep-disordered breathing, is estimated to affect around 1 billion people globally, out of the 7.3 billion population, specifically within the 30–69-year age-group.[50] In Asia, the estimated population-level prevalence of pulmonary hypertension (PH) ranges from 1 to 3%, while pulmonary arterial hypertension (PAH) remains rare, affecting approximately 15–30 individuals per million.[51] HTN management in respiratory disorders emphasizes calcium channel blockers as first-line agents and cautious use of BB based on the underlying pulmonary condition (Fig. 10).

Young-onset Hypertension

Hypertension among young people is common.[52] As per a study by Geevar et al., 11.2% of young adults were found to have HTN.[53] Management of HTN in young adults emphasizes lifestyle changes for borderline cases and pharmacotherapy with ACEIs, ARBs, or BBs when BP is persistently elevated or organ damage is present (Fig. 11).

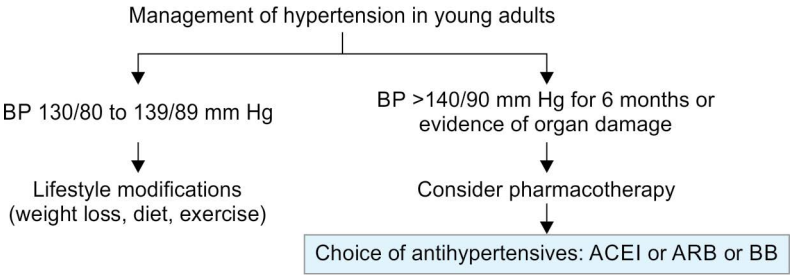


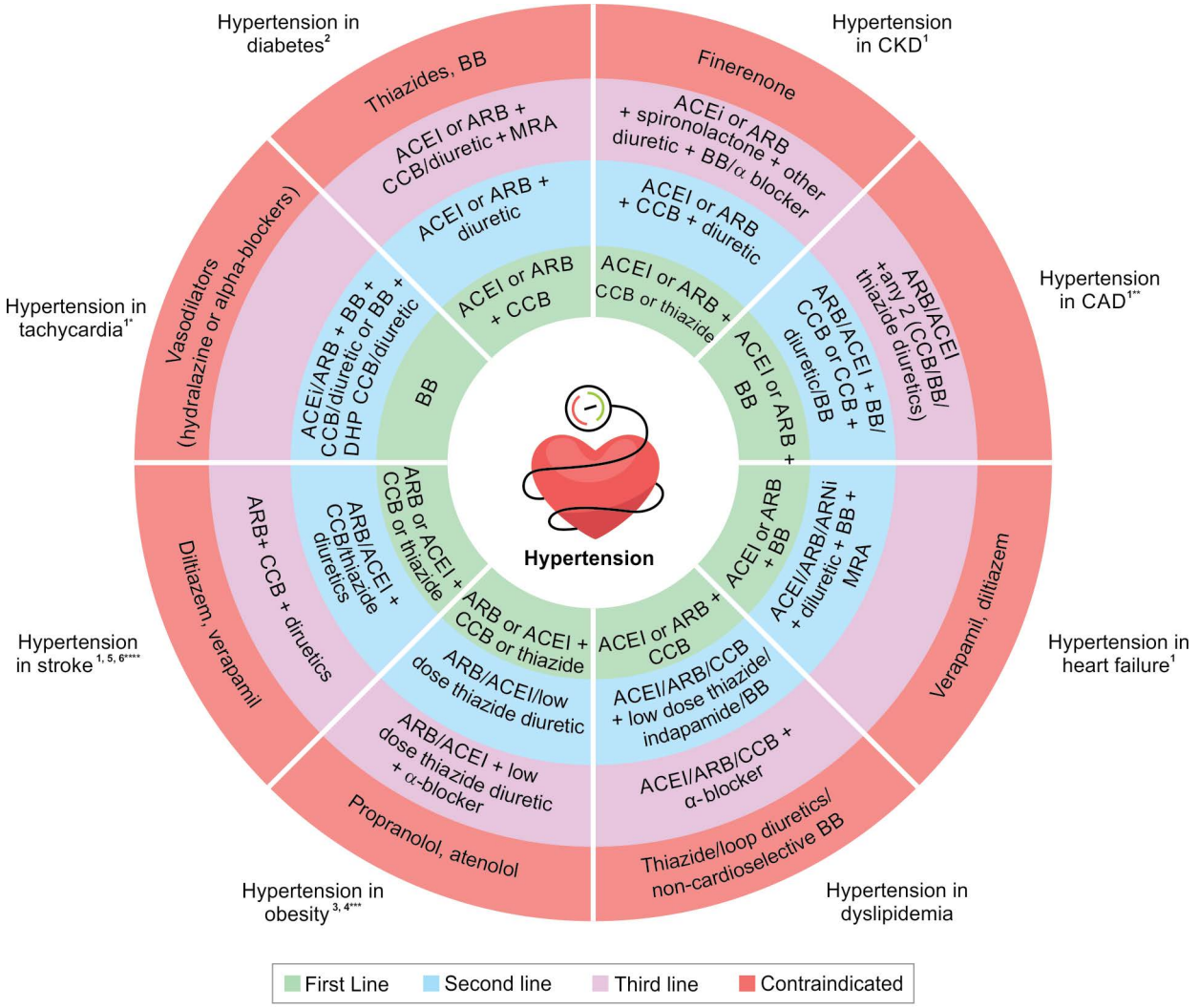
Fig. 11: Approach to HTN management in young adults

Therapeutic Wheel for the Management of HTN-associated Comorbidities

We propose India's first therapeutic wheel for HTN management outlining the first-line, second-line, and contraindicated antihypertensive medications for each comorbidity mentioned in the previous section (Fig. 12).

Monitoring of Blood Pressure

Hypertension is defined using the same cutoff as for ambulatory BP (135/85 mm Hg).



* Hypertension in Tachycardia: Consider non-DHP CCBs, or beta-blocker + CCB
** Hypertension in CAD: Consider monotherapy in low risk grade 1 HTN (SBP < 150 mmHg), or elderly (> 80 years) or frailer patients
*** Hypertension in Obesity: Consider ARB / ACEI monotherapy (ref -#3); ARB + CCB as first line: (ref #4), second line (ref #1), third line recommendation based on real world practice and Indian expert consensus
**** Hypertension in Stroke: Consider first line (ref #1), second and third line recommendation based on real world practice and Indian expert consensus

Fig. 12: Therapeutic wheel for HTN management with comorbidities

Conclusion

In conclusion, this multispecialty consensus underscores the critical importance of tailoring HTN management to individual patient profiles, considering specific BP phenotypes and associated comorbidities. By integrating comprehensive BP monitoring with personalized therapeutic strategies, healthcare providers can enhance treatment efficacy and improve patient outcomes. This approach not only addresses the unique characteristics of each patient but also aligns with the principles of precision medicine, ensuring that interventions are both targeted and effective.

Acknowledgments

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