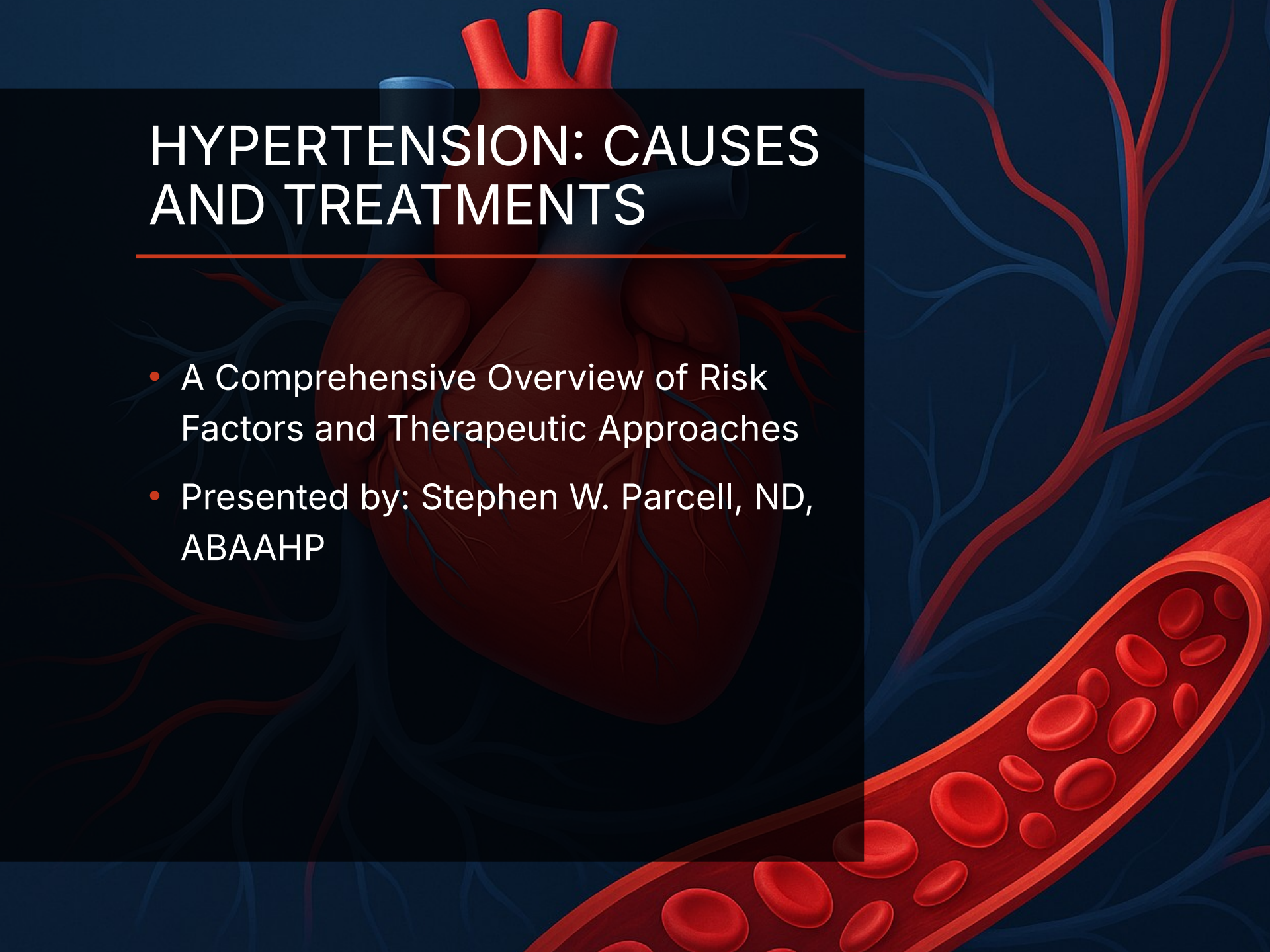
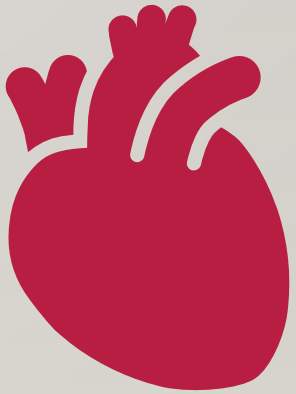
HYPERTENSION: CAUSES AND TREATMENTS

- A Comprehensive Overview of Risk Factors and Therapeutic Approaches
- Presented by: Stephen W. Parcell, ND, ABAAHP



OVERVIEW

- Epidemiology
- Definition of Hypertension
- Classification: Primary (Essential) & Secondary
- Pathophysiology
- Causes
- Sequalae
- Treatment



EPIDEMIOLOGY

- 25% of population BP >140/90 mmHg
- 50% of population BP >120/80 mmHg
- African and elderly
- Men have higher incidence until women hit menopause
- Major reason for medical visits and prescriptions

The endothelium and its overlying glycocalyx function as critical **gatekeepers**, acting as the primary sensors for chemical and physiological shifts within the bloodstream to regulate **blood flow** and **pressure** simple barriers, these layers actively modulate **immune responses**, inflammation, and oxidative stress.

The breakdown of the glycocalyx and a loss of **nitric oxide** bioavailability represent the earliest markers of **hypertension**, often appearing decades before a clinical diagnosis.

PATHOPHYSIOLOGY

Abnormal vascular biology with

- Endothelial dysfunction (ED), Glycocalyx dysfunction (GD), Vascular smooth muscle (VSM) dysfunction and cardiac dysfunction, Vasocontraction
- OXSTRESS with reactive oxygen species (ROS) and reactive nitrogen species (RNS)
- Inflammation with activated renin-angiotensin-aldosterone system (RAAS)
- Gene environment interactions

Hypertension: Many Insults → Three Responses → One Outcome

INFINITE INSULTS

- Genetics
- Aging
- Diet/salt
- Stress
- Obesity
- Insulin resistance
- Sleep disruption
- Toxins
- Autonomic imbalance
- Endothelial injury
- And many more…

Inflammation

Oxidative Stress

Immune Activation

HYPERTENSION

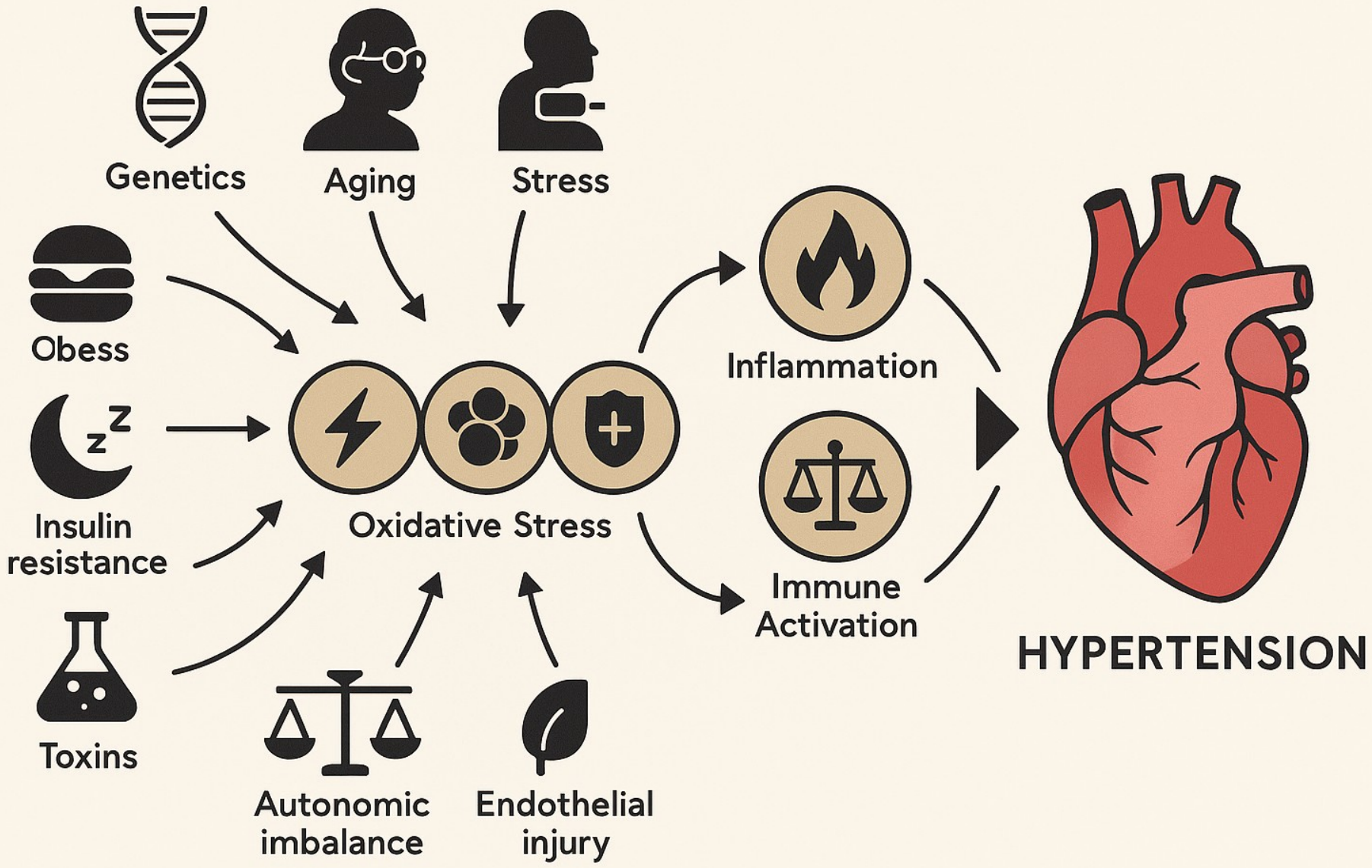
Diverse upstream stressors converge on a small number of conserved vascular response pathways.

INFINITE INSULTS-ONLY THREE FINITE RESPONSES

Hypertension is not a disease, but is the “correct” chronic dysregulated
vascular response with an exaggerated cardiovascular outcome from
infinite insults to the blood vessel.

Mark Houston, MD

ENDOTHELIUM AND GLYCOCALYX


Genetics
Aging
Stress
Obess
Insulin resistance
Toxins
Oxidative Stress
Autonomic imbalance
Endothelial injury
Inflammation
Immune Activation
HYPERTENSION

WHAT IS HYPERTENSION ?

Chronic condition with persistently elevated blood pressure/Often asymptomatic ('silent killer')

Diagnostic criteria per AHA:

- Normal: <120/80 mmHg
- Elevated: 120–129/<80 mmHg
- Stage 1: 130–139/80–89 mmHg
- Stage 2: ≥140/≥90 mmHg

PRIMARY HYPERTENSION (90–95%)

No identifiable single cause

Multifactorial origins:

- Genetics
- Aging
- Lifestyle: poor diet, lack of exercise
- Obesity & insulin resistance
- High sodium intake
- Stress & sleep disturbances

SECONDARY HYPERTENSION (5–10%)

Results from certain medical conditions:

- Kidney disease (renal artery stenosis)
- Endocrine disorders (Cushing's, pheochromocytoma)
- Obstructive sleep apnea
- Medications: NSAIDs, contraceptives, steroids
- Coarctation of the aorta

RISK FACTORS (MODIFIABLE & NON-MODIFIABLE)

Non-Modifiable:

- Age, Family history, Ethnicity

Modifiable:

- Smoking, Alcohol, Diet (high sodium), Inactivity
- Obesity, Stress

ETHNICITY AND POPULATION DIFFERENCES

People of African ancestry

- **Higher prevalence, earlier onset, and greater severity** of hypertension on average.
- More likely **salt sensitivity**, lower renin activity, and higher rates of hypertension-related complications (stroke, CKD).
- Often respond better to **thiazide diuretics and calcium channel blockers** as first-line therapy than to RAAS blockers alone.

East Asian populations

- Generally **high salt sensitivity**, contributing to hypertension and stroke risk despite lower average BMI.
- Strong blood pressure response to sodium reduction.

South Asian populations

- Increased cardiometabolic risk at **lower BMI**, with hypertension often clustering with insulin resistance and central adiposity.

European ancestry populations

- Wide variability; generally higher renin activity and better average response to **ACE inhibitors/ARBs**.

DIETARY FACTORS THAT INCREASE BLOOD PRESSURE

- Excess sodium intake is the strongest and most consistent dietary driver of hypertension. It is particularly impactful in salt-sensitive individuals, older adults, and people of African or East Asian ancestry, with processed and restaurant foods being the dominant sources.
- **Low potassium intake impairs natriuresis and vasodilation** and is common in diets low in fruits and vegetables. The combination of high sodium and low potassium markedly amplifies blood pressure risk.
- Ultra-processed foods contribute to hypertension through **high sodium content and low levels of potassium, magnesium, and fiber**. They also promote insulin resistance and vascular dysfunction independent of sodium.
- Excess added sugars, especially fructose, **increase uric acid production, leading to endothelial dysfunction and increased renal sodium retention**. Sugar-sweetened beverages are consistently associated with higher blood pressure.
- Refined carbohydrates promote **hyperinsulinemia, sympathetic nervous system activation, and renal sodium retention,** all of which contribute to elevated blood pressure.
- Excess alcohol intake raises blood pressure in a dose-dependent manner. Chronic intake above one drink per day in women or two drinks per day in men is associated with increased hypertension risk.
- Low dietary fiber intake is linked to higher blood pressure **through adverse effects on insulin sensitivity, gut microbiota, and systemic inflammation**.

AGE

- Age contributes to hypertension through **progressive vascular, renal, and regulatory changes** that raise blood pressure over time.
- **Large arteries stiffen** due to elastin loss, collagen accumulation, and calcification, increasing pulse wave velocity, systolic blood pressure, and pulse pressure—making isolated systolic hypertension common in older adults.
- **Endothelial dysfunction reduces nitric oxide availability**, increasing baseline vascular tone. Baroreceptor sensitivity declines, impairing short-term blood pressure regulation and increasing variability.
- **Age-related nephron loss** and reduced renal blood flow impair sodium excretion, leading to greater salt sensitivity and volume-dependent hypertension.
- **Sympathetic nervous system activity increases** while autonomic flexibility declines, further raising peripheral resistance.

NITRIC OXIDE

Nitric oxide (NO) is a **key regulator of vascular tone and blood pressure**, and its depletion with aging and adverse diet and lifestyle behaviors is a central mechanism in the development of hypertension.

Normal role of nitric oxide

- Nitric oxide is produced by endothelial cells via endothelial nitric oxide synthase (eNOS). It diffuses into vascular smooth muscle, where it induces relaxation, reduces vascular resistance, inhibits platelet aggregation, and suppresses inflammation and vascular remodeling. Adequate NO availability allows arteries to dilate in response to flow and metabolic demand, buffering rises in blood pressure.

Age-related nitric oxide depletion

- With aging, NO bioavailability declines due to:
- Reduced eNOS expression and activity
- Increased oxidative stress that scavenges NO
- Endothelial cell senescence
- This leads to impaired vasodilation, higher baseline vascular tone, increased arterial stiffness, and loss of normal blood pressure buffering, contributing to systolic hypertension and widened pulse pressure.

AFFECT ON THE BRAIN

Neurological System (Cerebrovascular)

- **Stroke (Ischemic and Hemorrhagic)**
  - Chronic high BP can lead to atherosclerosis (causing ischemic stroke) or rupture of weakened vessels (causing hemorrhagic stroke).
- **Transient Ischemic Attacks (TIAs)**
- **Vascular Dementia**
  - Due to chronic cerebral hypoperfusion and small vessel disease (white matter).
- **Hypertensive Encephalopathy**
  - Acute confusion, headache, seizures due to cerebral edema.

COGNITIVE DECLINE INDEPENDENT OF WMD AND VASCULAR DEMENTIA

Chronic hypertension causes cerebral microvascular remodeling, reducing baseline perfusion and impairing autoregulation without causing infarction	High-demand brain regions (hippocampus, prefrontal cortex) experience functional hypoxia, affecting memory and executive function	Endothelial dysfunction and reduced nitric oxide impair neurovascular coupling during cognitive activity
Blood–brain barrier disruption allows inflammatory mediators into the brain, triggering low-grade neuroinflammation	Microglial activation interferes with synaptic plasticity and learning	Altered arterial pulsatility impairs glymphatic clearance of metabolic waste (amyloid-β, tau)
Oxidative stress and mitochondrial dysfunction reduce neuronal energy efficiency	Stress-axis activation and elevated cortisol further impair memory and cognition	Results in gradual decline in executive function, processing speed, and memory despite normal structural imaging

CARDIOVASCULAR SYSTEM

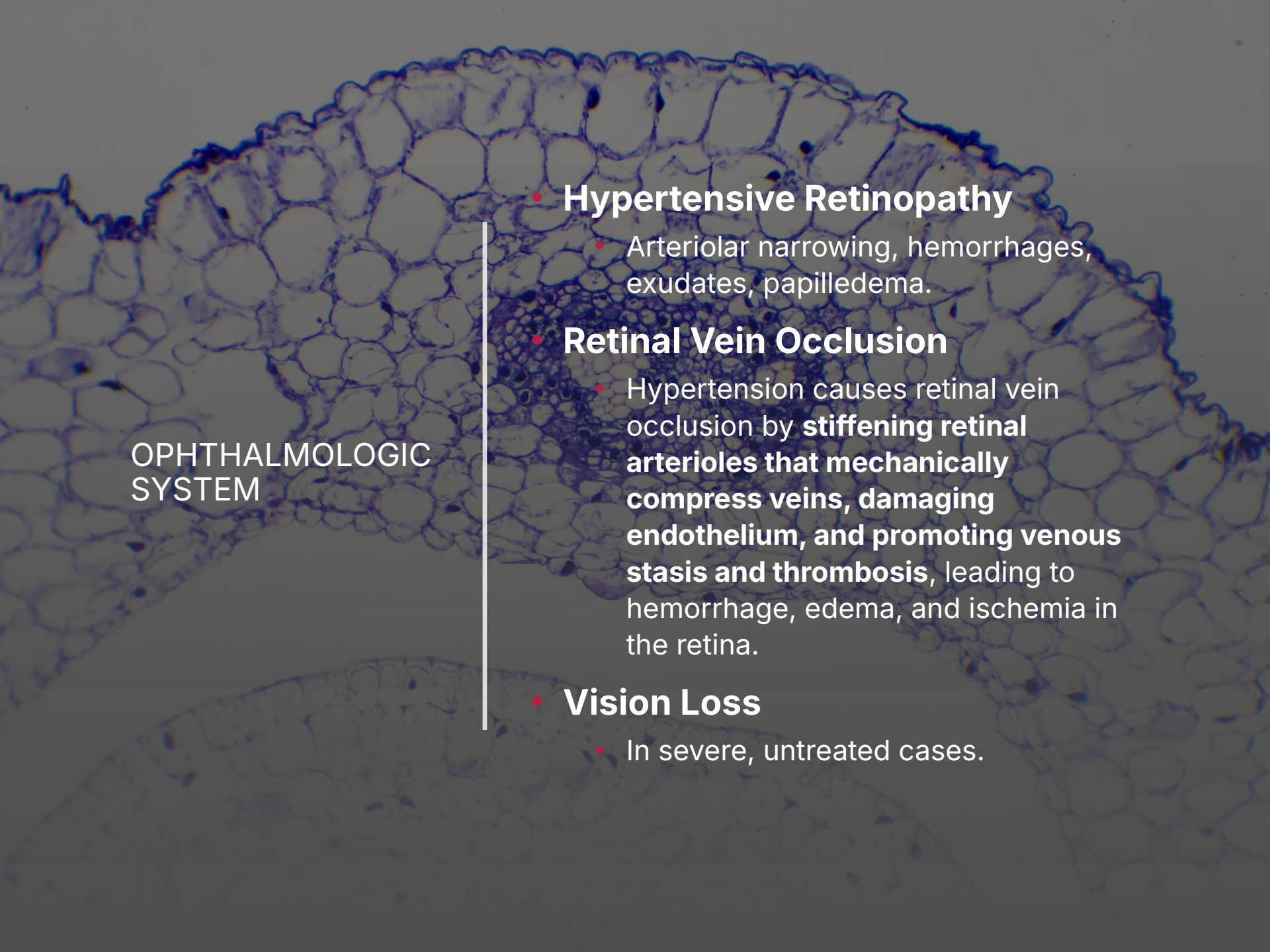
Left Ventricular Hypertrophy (LVH)	• Heart muscle thickens, increasing risk of arrhythmias and heart failure.
Heart Failure (Both HFrEF and HFpEF)	• Resulting from chronic pressure overload. • Decompensation
Coronary Artery Disease (CAD)	• Accelerated atherosclerosis due to vascular injury.
Myocardial Infarction (plaque rupture)	
Atrial Fibrillation	• Due to atrial stretch and remodeling.
Aortic Aneurysm and Dissection	• Particularly thoracic aorta.
Sudden Cardiac Death	

RIGHT SIDED HEART FAILURE

- **Hypertension → Left HF → Pulmonary HTN → Right HF**
  But hypertension **rarely** causes isolated **primary right-sided heart failure**.
- **Hypertension can lead to right-sided heart failure**, but typically as a **consequence of left-sided failure or pulmonary hypertension**, not as a direct, isolated effect.

RENAL

- **Hypertensive Nephropathy**
  - Hypertensive nephropathy is **slow, silent kidney damage from chronic high blood pressure**, driven by microvascular injury and progressive scarring, and is a major, preventable cause of chronic kidney disease.
    - CKD Nephrosclerosis due to glomerular ischemia.
- **End-Stage Renal Disease (ESRD)**
  - May require dialysis or transplant.

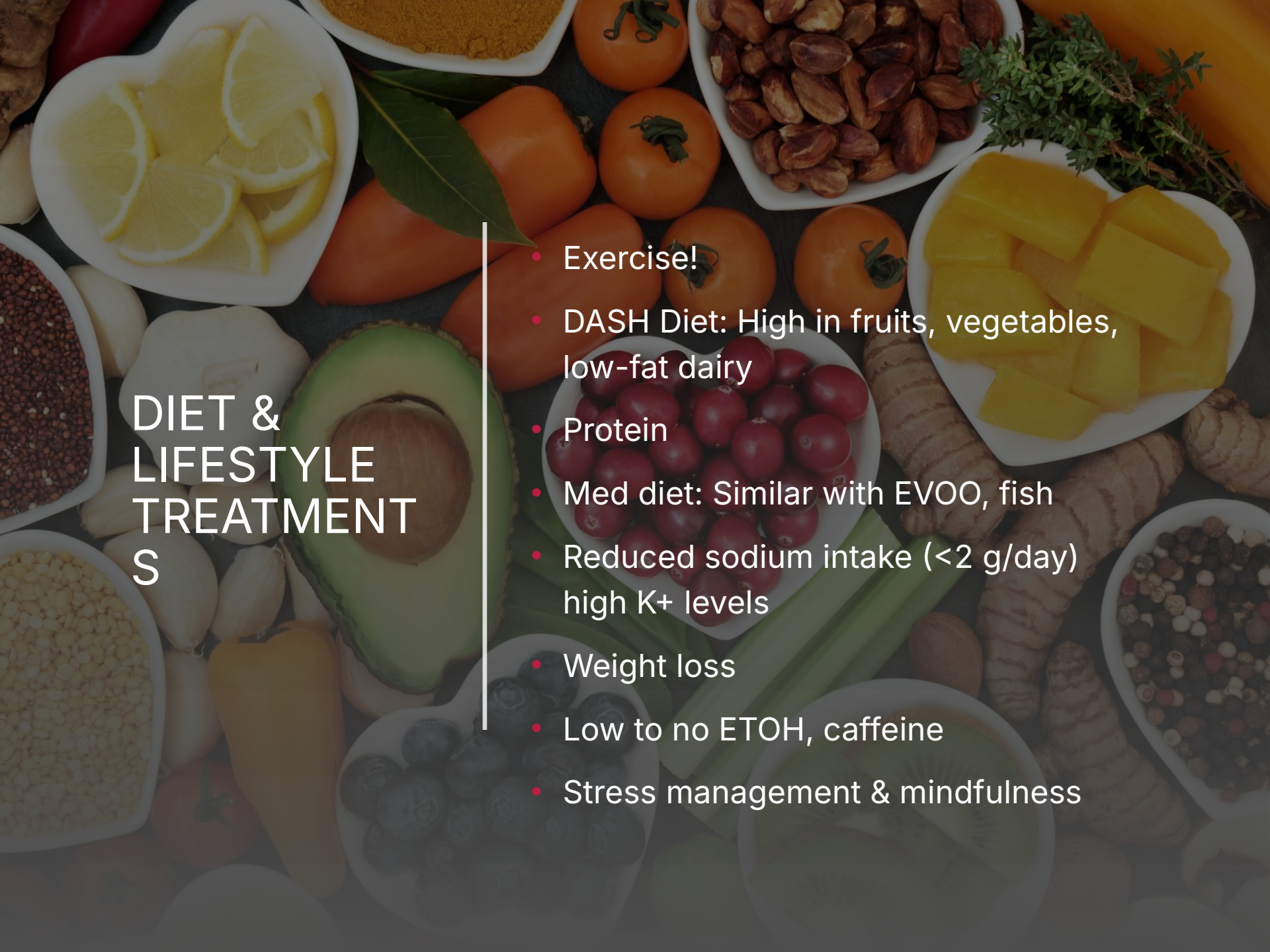


OPHTHALMOLOGIC SYSTEM

- **Hypertensive Retinopathy**
  - Arteriolar narrowing, hemorrhages, exudates, papilledema.
- **Retinal Vein Occlusion**
  - Hypertension causes retinal vein occlusion by **stiffening retinal arterioles that mechanically compress veins, damaging endothelium, and promoting venous stasis and thrombosis**, leading to hemorrhage, edema, and ischemia in the retina.
- **Vision Loss**
  - In severe, untreated cases.

PULMONARY SYSTEM

- **Pulmonary Edema**
  - Due to left heart failure. Hypertension-induced left heart failure causes pulmonary edema by **raising left ventricular filling pressures**, which are transmitted backward to the pulmonary capillaries, **overwhelming Starling forces (**When pulmonary capillary hydrostatic pressure exceeds oncotic pressure) **and driving fluid into the alveoli**, especially during acute blood pressure elevations.
- **Hypertensive Pulmonary Hypertension**
  - Indirect effect from left-sided heart disease. Hypertensive pulmonary hypertension is **not a primary lung or pulmonary artery disorder**. It is a **downstream consequence of chronic systemic hypertension causing left heart dysfunction**, leading to persistently elevated pulmonary pressures and, if untreated, eventual right heart failure.



DIET & LIFESTYLE TREATMENTS

- Exercise!
- DASH Diet: High in fruits, vegetables, low-fat dairy
- Protein
- Med diet: Similar with EVOO, fish
- Reduced sodium intake (<2 g/day) high K+ levels
- Weight loss
- Low to no ETOH, caffeine
- Stress management & mindfulness

SUPPLEMENTS WITH POTENTIAL BENEFIT

- Omega-3 fatty acids
- Coenzyme Q10
- Magnesium
- Beetroot juice (nitrate-rich)
- Hibiscus tea
- Use under clinical guidance

PHARMACEUTICAL TREATMENTS – OVERVIEW

- Treatment guided by BP stage, comorbidities, age, race
- Main classes:

1. - ACE Inhibitors (e.g., Lisinopril)
2. - ARBs (e.g., Losartan, less side effects)
3. - Calcium Channel Blockers (e.g., Amlodipine)
4. - Thiazide Diuretics (e.g., Hydrochlorothiazide)
5. - Beta Blockers (e.g., Metoprolol – selected cases)

TREATMENT ALGORITHM (ACC/AHA 2017 GUIDELINES)

- Lifestyle changes for all patients
- Stage 1 + CVD risk → Meds + Lifestyle
- Stage 2 → Two Medications + Lifestyle
- Goal BP: <130/80 mmHg

SPECIAL POPULATIONS

- Elderly: start low, go slow
- Pregnancy: Methyldopa, Labetalol preferred
- CKD: ACE inhibitors or ARBs
- Diabetes: ACE inhibitors/ARBs preferred

ADHERENCE AND MONITORING

- Importance of home BP monitoring
- Medication adherence strategies
- Regular follow-up & addressing side effects

SUMMARY & KEY TAKEAWAYS

- Hypertension is multifactorial and often silent
- Lifestyle modification is foundational
- Medications are effective when individualized
- Ongoing monitoring is critical
- Prevention through awareness is key

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