



HYPERTENSION IN ATHLETES & ACTIVE ADULTS

SARA NEAL MD, MA

AUGUST 8, 2020

disclosures

I HAVE NOTHING TO DISCLOSE



goals

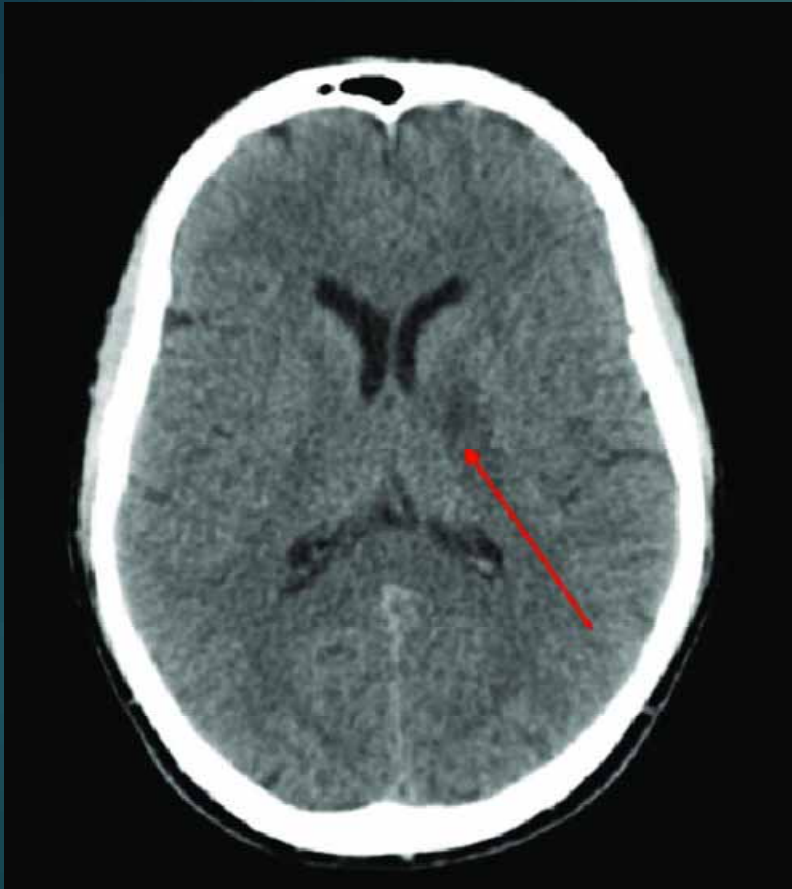
- ▶ Understand that HTN in athletes may be elusive
- ▶ Know how far to go in your work up of a suspicious BP reading
- ▶ Understand the effects of hypertension on exercise physiology
- ▶ Understand treatment options and what NOT to use
- ▶ Know when to restrict a hypertensive athlete from play

CASE

- ▶ 28-year-old defensive lineman
- ▶ History of hypertension for 10 years
- ▶ BP well controlled last 3 years with use of diuretic
- ▶ Immediately after a game, he was noted to have:
 - Slurred speech
 - Inability to walk straight forward; he veered to the right when attempting to walk forward

WORKUP

- ▶ CT head
- ▶ Coagulation panel including Antiphospholipid etc
- ▶ Sickle cell screen
- ▶ Carotid imaging
- ▶ Echocardiogram
- ▶ All normal except:
- ▶ Head CT showing small internal capsular infarct



- ▶ Ischemic strokes common in the internal capsule (IC) area
- ▶ IC area has small diameter arteries
- ▶ CAUSES of these lacunar infarcts:
- ▶ Chronic HTN can cause thickening of vessel wall (*lipohyalinosis*)
- ▶ Embolism
- ▶ ASCVD of larger trunk vessels

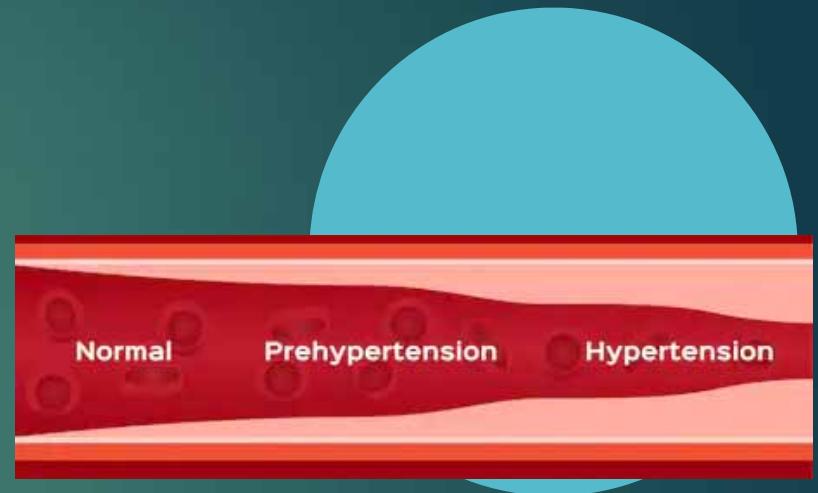
CASE

- ▶ Ultimately had full workup with MRI, MRA ECHO etc
- ▶ All negative
- ▶ Fortunately, full recovery

Risk for stroke thought to be long term effects of previously untreated hypertension (*lipohyalinosis*)

HTN FACTS

- ▶ HTN most common CV disorder in USA and worldwide
- ▶ HTN also most common CV disorder in athletes (*Schleich*)



PREVALENCE OF HTN IN USA

- ▶ Prevalence of HTN among US adults > 20 yoa is 32.6% (NHANES 2012)

AGE RANGE	PREVALENCE HTN
18-39	7.3%
40-59	32.4%
> 60	65.0%

- ▶ Projections show that by 2030, approximately 41.4% of US adults will have hypertension,
- ▶ This is an increase of 8.4% from 2012 NHANES estimates (Heidenreich)

Intersection of MD with athlete

- ▶ **THE**
- ▶ **PRE-PARTICIPATION**
- ▶ **EXAM**



PRE-PARTICIPATION EXAMINATION (PPE)

Blood pressure status
for athletes is usually a
single reading at PPE



PRE-PARTICIPATION EXAMINATION (PPE)

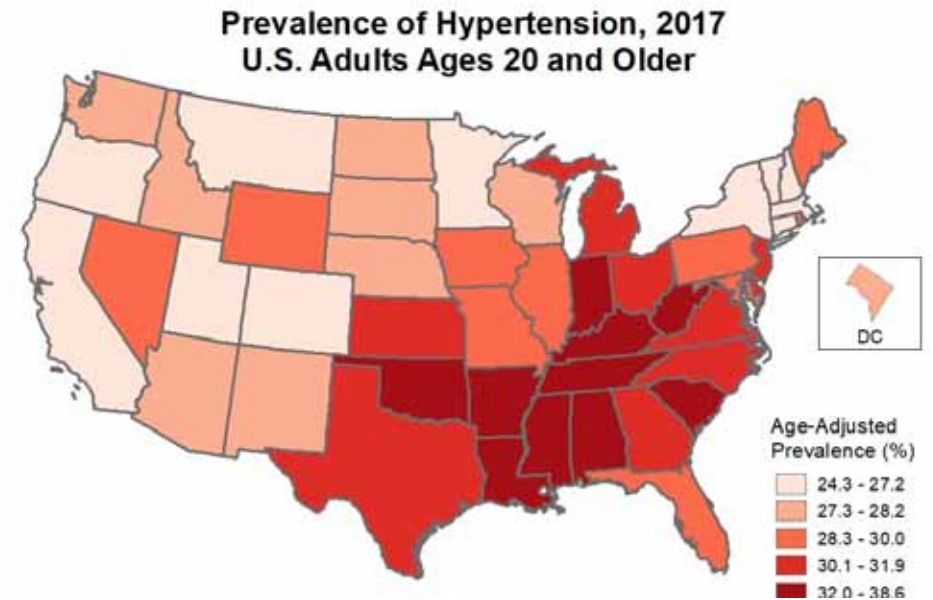
Blood pressure status for athletes is usually a **single reading** at PPE

Elevated BP readings are the **most common abnormality** found at pre-participation exams (*Kouidi*)

Study of adolescent athletes:
80% of those w BP > 142/92 at PPE were found to eventually develop HTN (*Tanji*)

PRE-PARTICIPATION EXAMINATION

Likely to see more of this given adolescent obesity epidemic



Study on adolescents in Mississippi

- ▶ 7700 student athletes ages 14-18
- ▶ Looked at obesity and hypertension
- ▶ 23% obese (BMI > 95%)
- ▶ 20% overweight (BMI >85% <95%)

Obese students were **2.4X** more likely to have elevated BP at pre-participation exam
(Stiefel)

DEFINITION HTN: ADULTS

JNC – 8 Classification of BP

- ▶ Also consider if there is presence of target organ damage (TOD) or not

Table 3. Classification of Blood Pressure in Adults (age ≥18 years)

Classification	Systolic Blood Pressure (mmHg)		Diastolic Blood Pressure (mmHg)
Normal	<120	AND	<80
Prehypertension	120-139	OR	80-89
Stage 1 HTN	140-159	OR	90-99
Stage 2 HTN	≥160	OR	≥100

DEFINITION HTN: PEDIATRICS

Children < 13 yoa: BP is rated against demographic norms

does it exceed 90%?

95%?

99%?

Children > 13 similar numbers to adults

secondary hypertension was previously more common in children

primary hypertension now accounts for most cases of childhood hypertension
(Kapur)

Updated Definitions of BP Categories and Stages

For children aged 1-13 y

Normal BP: < 90th percentile

Elevated BP: \geq 90th percentile to < 95th percentile or 120/80 mm Hg to < 95th percentile (whichever is lower)

Stage 1 HTN: \geq 95th percentile to < 95th percentile + 12 mm Hg, or 130/80 to 139/89 mm Hg (whichever is lower)

Stage 2 HTN: \geq 95th percentile + 12 mm Hg, or \geq 140/90 mm Hg (whichever is lower)

For children aged \geq 13 y

Normal BP: < 120/< 80 mm Hg

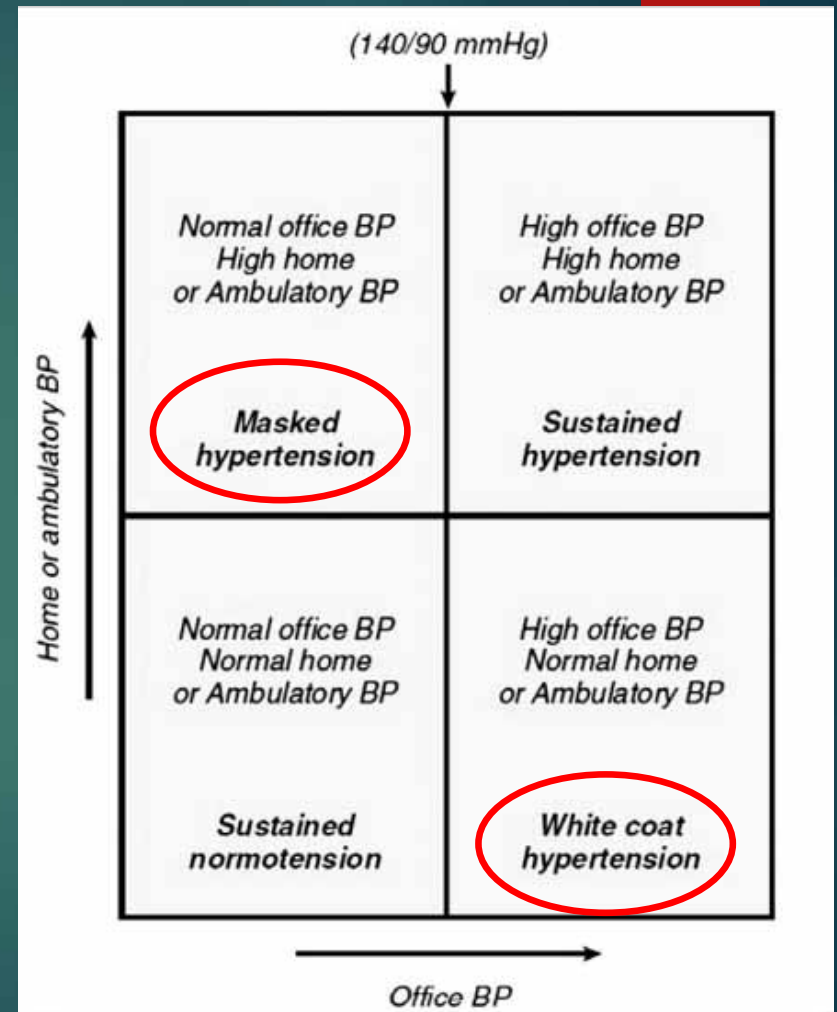
Elevated BP: 120/< 80 to 129/< 80 mm Hg

Stage 1 HTN: 130/80 to 139/89 mm Hg

Stage 2 HTN: \geq 140/90 mm Hg

MASKED HTN & WHITE COAT HTN (WCH)

- ▶ Masked hypertension was defined as an office BP <140/90 mmHg but an ABP average \geq 135/85 mmHg
- ▶ Ambulatory BP monitor considered gold standard evaluation for suspected WCH, but ...
- ▶ Home BP with appropriate cuff, training and done 2 or more times a day has been shown to be sufficient to rule out white coat HTN (*Anderson*)



MASKED HTN

- ▶ May be particularly important in the athlete
- ▶ Small study in Norwegian “football” players who were selected due to elevated BP at PPE
- ▶ Set up for Ambulatory BP
- ▶ Measured against control group, age matched, optimal BP readings
- ▶ 58% of players with elevated initial BP readings had sustained HTN
- ▶ 11% had WCH
- ▶ More than one-third of the control group had masked hypertension during daytime
- ▶ Additionally, these groups had a reduced nocturnal dip in BP, potentially indicating increased nocturnal sympathetic activity

HOW FAR DO YOU GO WITH WORK-UP?

- ▶ An abnormal blood pressure reading should be followed up
- ▶ Recheck at same office visit
- ▶ Check in other arm
- ▶ Consider outpatient records
- ▶ Consider family history
- ▶ Repeat home blood pressures.
- ▶ Is ambulatory blood pressure monitoring an option?
- ▶ If blood pressures remain high, consider creatinine, ECHO, referral.



PHYSIOLOGY: EXERCISE IN NORMAL vs HTN

HTN patients have greater increase SBP, DBP, MAP, HR & sympathetic activity in both dynamic and static exercise



DYNAMIC EXERCISE	NORMAL	HTN
SBP	↑	↑↑
DBP	→ ↓	↑
MAP	→ ↑	↑↑
HR	↑	↑↑
SYMPATHETIC EFFERENT ACTIVITY	↑	↑↑

EXERCISE PHYSIOLOGY IN ATHLETES WITH HTN

- ▶ A disproportionate response to exercise is seen in athletes with HTN or pre-HTN
- ▶ These individuals have an **inverse, independent, and graded association** between exercise capacity and their mortality risk
- ▶ a cohort of 4631 hypertensive veterans with multiple cardiovascular risk factors
- ▶ all successfully completed a graded exercise test
- ▶ mortality risk was 13% lower for every 1-MET increase in exercise capacity they achieved. (*Myers*)

EXERCISE AS TREATMENT



- ▶ In hypertensive individuals, habitual physical activity lowers BP and the risk of mortality, independent of other risk factors.
- ▶ increased cardiorespiratory fitness attenuates the 24-hour BP and the BP response to exercise or physical exertion, thereby lowering the risk for LVH. (*Kokkinos*)

TREATMENT OPTIONS

LIFESTYLE MODIFICATIONS (LSM)

Individual modifications may only drop BP a little, but combinations of changes may make significant difference

LSM and change in SBP mm Hg

- ▶ Recent tobacco use 10-12
- ▶ Oral contraceptives 8-15
- ▶ High sodium intake 2-14
- ▶ Recent alcohol intake 2-4
- ▶ Cocaine 8-?
- ▶ Anabolic steroids 9-10
- ▶ NSAIDS 2-4
- ▶ Energy drinks 2-8

TREATMENT OPTIONS: BENEFIT OF EXERCISE ON BLOOD PRESSURE

- ▶ Regular aerobic (dynamic) exercise can reduce BP in hypertensive and in normotensive
- ▶ Systolic drop 4-9 mm
- ▶ Diastolic drop 3-6 mm
- ▶ Static exercise: capable of lowering resting BP in hypertensive and normotensive
- ▶ a recent meta-analysis, static exercise was shown to reduce systolic 10.9 mm Hg and diastolic by 6.2 mm Hg,

TREATMENT OPTIONS: MEDICATIONS

ANTIHYPERTENSIVE TREATMENT OPTIONS BY CLASS

- ▶ ACE inhibitors
- ▶ Alpha blockers/Alpha agonists
- ▶ Angiotensin receptor blockers
- ▶ Beta blockers
- ▶ Calcium channel blockers
- ▶ Direct Renin inhibitors
- ▶ Diuretics
- ▶ Vasodilators

TREATMENT OPTIONS: MEDICATIONS

ANTIHYPERTENSIVE TREATMENT OPTIONS BY CLASS

- ▶ ACE inhibitors
- ▶ ~~Alpha blockers/Alpha agonists~~
- ▶ Angiotensin receptor blockers
- ▶ ~~Beta blockers~~
- ▶ Calcium channel blockers
- ▶ Direct Renin inhibitors ?
- ▶ ~~Diuretics~~
- ▶ ~~Vasodilators~~

TREATMENT OPTIONS: MEDICATIONS

ANTIHYPERTENSIVE TREATMENT OPTIONS BY CLASS

- ▶ **ACE inhibitors**
- ▶ ~~Alpha blockers/Alpha agonists~~
- ▶ **Angiotensin receptor blockers**
- ▶ ~~Beta blockers~~
- ▶ **Calcium channel blockers**
- ▶ ~~Direct Renin Inhibitors~~
- ▶ ~~Diuretics~~
- ▶ ~~Vasodilators~~

TREATMENT OPTIONS: MEDICATIONS

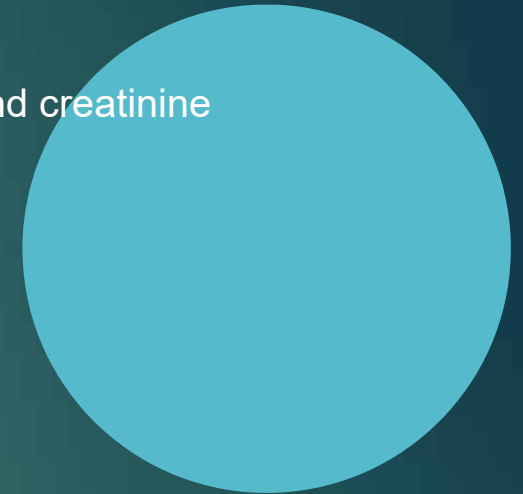
ANTIHYPERTENSIVE TREATMENT OPTIONS BY CLASS

- ▶ **ACE inhibitors**
- ▶ **Angiotensin receptor blockers**
- ▶ **Calcium channel blockers**

TREATMENT OPTIONS: ACE & ARB

- ▶ ACE & ARB shown to have little or no effect on exercise capacity
(Carre, D'Esta, Barrow)

- ▶ Evaluate electrolytes and creatinine



TREATMENT OPTIONS: ACE & ARB

- ▶ ACE & ARB shown to have little or no effect on exercise capacity
(Carre, D'Esta, Barrow)

HOWEVER ...

TREATMENT OPTIONS: ACE & ARB

- ▶ **Contraindicated in women of child-bearing** age (fetal abnormalities)
- ▶ **Risk of angioedema**
 - 5X in African American (*Brown*)
 - Increased in Latino (*Kaplan*)
 - 10% risk of angioedema with ARB if it occurred with ACE (*Beavers*)
- ▶ **Cough** (less but still possible with ARB; up to 29% who have cough with ACE will have cough with ARB) (*Product*)

TREATMENT OPTIONS: CALCIUM CHANNEL BLOCKERS

DIHYDROPYRIDINES
VS
NON-DIHYDROPYRIDINES

Memory trick:
HYDRATION is good
for athletes...
Therefore
diHYDRopyridines are
good for athletes

TREATMENT OPTIONS: CALCIUM CHANNEL BLOCKERS



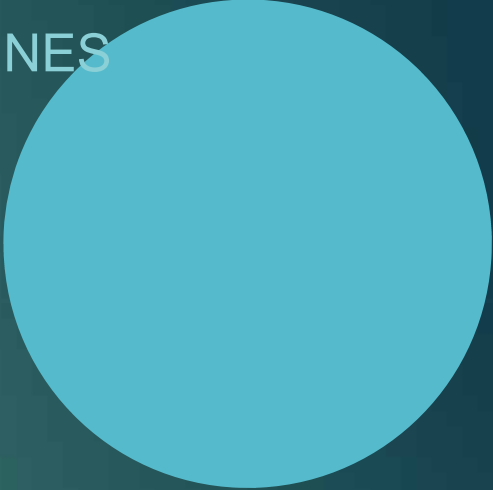
NON-DIHYDROPRIDINES

- ▶ VERAPAMIL
- ▶ DILTIAZEM

- ▶ Less vasodilation
- ▶ Can cause reductions in heart rate and contractility due to effects on SA & AV nodes
- ▶ Verapamil most pronounced negative inotropic effect

DIHYDROPYRIDINES

- ▶ Nifedipine
 - ▶ Felodipine
 - ▶ Amlodipine
 - ▶ Nicardipine

 - ▶ More vascular selectivity and fewer cardiac effects
 - ▶ Do not suppress nodes automaticity (rate) or conduction (contractility)
- 

TREATMENT OPTIONS: CALCIUM CHANNEL BLOCKERS

- ▶ CCB may be especially helpful in African American athletes as CCB decrease vascular resistance (*important component of pathogenesis HTN in AA*)
- ▶ Non-dihydropyridines (Verapamil and Diltiazem) can have effect on maximum heart rate
- ▶ Dihydropyridines can cause small decrease in VO₂ max.
- ▶ For most, these are usually thought to be negligible effects

TREATMENT OPTIONS: CALCIUM CHANNEL BLOCKERS

- ▶ In theory, CCB can increase risk of heat –related illness.
- ▶ Theoretical mechanism : as they vasodilate, hypotension and interference with thermoregulation
- ▶ Dihydropyridines usually well tolerated except for dose dependent edema (10%)
- ▶ No specific lab monitoring necessary
- ▶ **OK for women of child- bearing age**

TREATMENT OPTIONS: WHAT NOT TO USE (and reasons)

- ▶ Diuretics: intravascular volume depletion, electrolyte disturbance; can decrease threshold for heat illness. Cramps.
- ▶ Thiazides especially can act as masking agents for anabolic steroids
- ▶ Beta blockers are banned for sports requiring fine motor movements:
Darts, Archery, Billiards, Golf, Biathlon, Riflery/shooting
- ▶ Beta blockers also banned for:
Underwater sports, Automobile racing, Skiing, Snowboarding

WHEN TO RESTRICT FROM PLAY



WHO CAN PLAY?

PREHYPERTENSION

- ▶ No restrictions
- ▶ Need appropriate follow-up

STAGE 1 HTN WITH NO TARGET ORGAN DAMAGE

- ▶ No restrictions
- ▶ Treat and monitor every 2-4 months
- ▶ See how training is affecting BP

STAGE 1 HYPERTENSION WITH TARGET ORGAN DAMAGE

- ▶ Play is **RESTRICTED** until BP target of $<140/90$ is achieved

STAGE 2 HTN ($> 160/100$)

- ▶ **RESTRICTED** until BP target of $<140/90$ is achieved
- ▶ Especially true in sports with intense dynamic and static components (boxing, triathlon, speed skating, rowing)

WHO CAN PLAY? (PEDS)

PRE-HYPERTENSION

- ▶ No restrictions on play but...
- ▶ Follow-up every 6 months

STAGE 1 (>95%) NO TARGET ORGAN DAMAGE (TOD)

- ▶ No restrictions on play
- ▶ Follow-up every 1-2 weeks

STAGE 1 WITH TOD OR STAGE 2 HTN

- ▶ **RESTRICT from sport**
- ▶ Refer to pediatric HTN specialist

RISKS OF OLDER ATHLETES WITH HTN



- ▶ Athletes >35 have increased risk for CAD and may need additional work up. Consider ECHO and exercise tolerance testing
- ▶ Systolic >225-240 warrants further attention
- ▶ Rise in diastolic BP during exercise may indicate elevated systemic vascular resistance
- ▶ Failure of BP to fall by 3 mins post ETT – consider CAD?

SUMMARY



- ▶ HTN most common CV disorder in athletes
- ▶ The overall risk of CV disease cannot be dismissed due to the thought that routine physical activity may be cardioprotective.
- ▶ Do not neglect full work up for any elevated blood pressure
- ▶ Control BP without affecting exercise capacity, without lowering heat illness threshold, without using banned substance
- ▶ Restrict play until blood pressure is controlled in any patient with stage 2 hypertension
- ▶ Restrict play in any patient with target organ damage until further evaluation and treatment