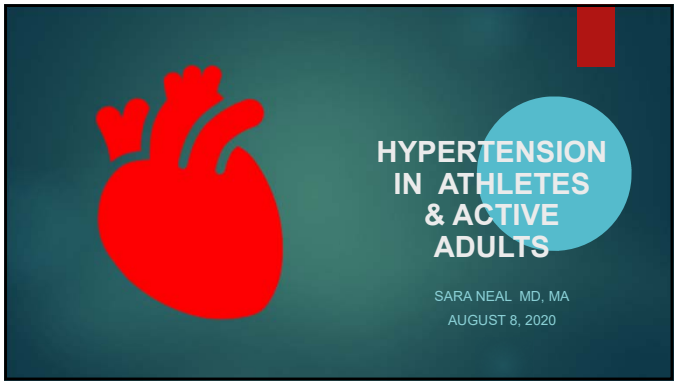
HYPERTENSION IN ATHLETES & ACTIVE ADULTS
SARA NEAL MD, MA
AUGUST 8, 2020

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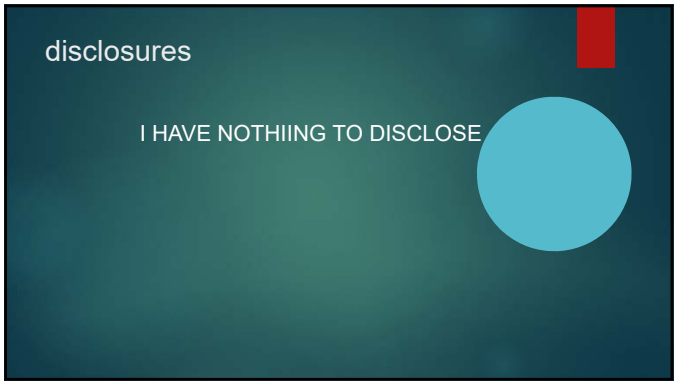
disclosures
I HAVE NOTHIING TO DISCLOSE

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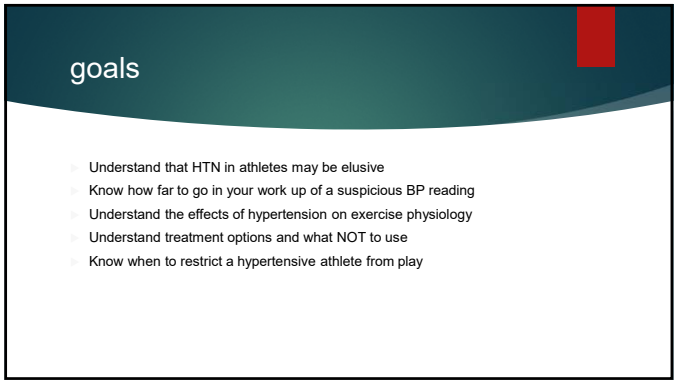
goals
Understand that HTN in athletes may be elusive
Know how far to go in your work up of a suspicious BP reading
Understand the effects of hypertension on exercise physiology
Understand treatment options and what NOT to use
Know when to restrict a hypertensive athlete from play

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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

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WORKUP

- CT head
- Coagulation panel including Antiphospholipid etc
- Sickle cell screen
- Carotid imaging
- Echocardiogram

- All normal except:
- Head CT showing small internal capsular infarct

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- 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

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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)*

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HTN FACTS

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

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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)*

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Intersection of MD with athlete

- THE
- PRE-PARTICIPATION
- EXAM

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PRE-PARTICIPATION EXAMINATION (PPE)

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

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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)*

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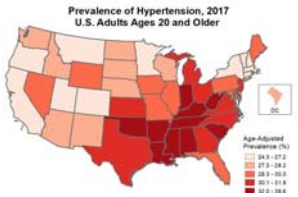
PRE-PARTICIPATION EXAMINATION

Likely to see more of this given adolescent obesity epidemic



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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)*

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DEFINITION HTN: ADULTS

JNC – 8 Classification of BP

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 I HTN	140-159	OR	90-99
Stage 2 HTN	≥160	OR	≥100

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

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DEFINITION HTN: PEDIATRICS

Updated Definitions of BP Categories and Stages

For children aged 1-13 y	For children aged ≥ 13 y
Normal BP: < 90th percentile	Normal BP: < 120/< 80 mm Hg
Elevated BP: ≥ 90th percentile to < 95th percentile or 120/80 mm Hg to < 95th percentile (whichever is lower)	Elevated BP: 120/< 80 to 129/ < 80 mm Hg
Stage 1 HTN: ≥ 95th percentile to < 95th percentile + 12 mm Hg, or 130/80 to 139/89 mm Hg (whichever is lower)	Stage 1 HTN: 130/80 to 139/89 mm Hg
Stage 2 HTN: ≥ 95th percentile + 12 mm Hg, or ≥ 140/90 mm Hg (whichever is lower)	Stage 2 HTN: ≥ 140/90 mm Hg

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)*

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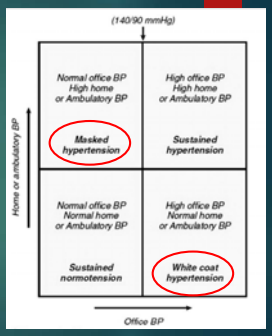
MASKED HTN & WHITE COAT HTN (WCH)

- Masked hypertension was defined as an office BP <140/90 mmHg but an ABP average ≥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)*



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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

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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.

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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	↑	↑↑

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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)*

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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)*

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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

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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,

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TREATMENT OPTIONS: MEDICATIONS

ANTIHYPERTENSIVE TEATMENT OPTIONS BY CLASS

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

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TREATMENT OPTIONS: MEDICATIONS

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- **Calcium channel blockers**

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TREATMENT OPTIONS: ACE & ARB

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

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TREATMENT OPTIONS: ACE & ARB

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

HOWEVER …

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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)

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TREATMENT OPTIONS: CALCIUM CHANNEL BLOCKERS

DIHYDROPYRIDINES

VS

NON-DIHYDROPYRIDINES

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

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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)

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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

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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**

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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

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WHEN TO RESTRICT FROM PLAY

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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)

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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

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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?

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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

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