

***Breaking Boundaries in Adrenal Disorders***

# **ANAH - AFES Joint Symposium 2025**

**14 – 16 Nov 2025 | Ariyana Convention Center, Da Nang city, Vietnam**



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## *Meet-the-Professor Session*



# **Adrenal Disorders in Pregnancy: Challenges in Diagnosis and Treatment**

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# Objectives

**At the end of the session, you will be able to:**

- **Recognize adrenal disorders in pregnancy, specifically:**
  - Adrenal Insufficiency (AI) and Adrenal Crisis
  - Cushing Syndrome (CS)
  - Primary Aldosteronism (PA)
  - Pheochromocytoma
- **Understand the pathophysiology complicating pregnancy and address the challenges on**
  - Diagnosis
  - Treatment



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## Meet-the-Professor Session

# Case-Based Discussion



# Case 1

- 29 years old
- G1P0
- Age of Gestation, 10 weeks
- Diagnosed and operated for Pituitary Cushing Disease at age 23 years
- On hydrocortisone replacement therapy
- **(+) nausea and vomiting**
- Physical examination:
- BP: 120/80, PR: 78
- Negative for orthostatic hypotension
- No cushingoid features

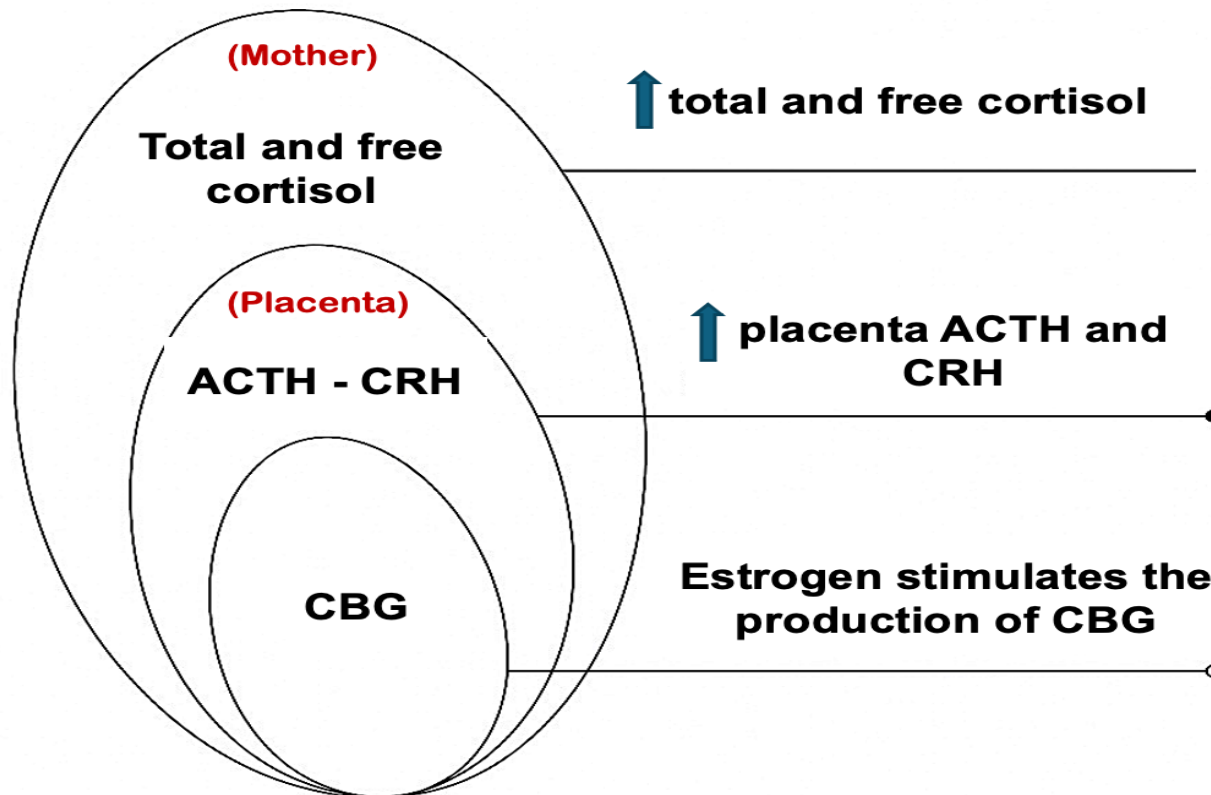




## Choose the Best Answer: **What to do?**

- A. The nausea and vomiting are signs of adrenal insufficiency (AI), so **outright increase the dose of hydrocortisone.**
- B. There is negative orthostatic hypotension, **so observe further.**
- C. **Do hormonal test** to fully assess the situation.

# AI in Pregnancy: Changes in HPA Axis *Challenges*



**The peak is at 26 weeks**  
**Diurnal variation is maintained**

**ACTH directly acts on the adrenal gland**  
**CRH stimulates the adrenal gland directly and indirectly**

**↑ pituitary ACTH levels**  
**↑ adrenal cortisol secretion**



# AI in Pregnancy: *Diagnosis*

- Signs and Symptomatology
  - Weight loss
  - Prolonged vomiting
  - Hyperpigmentation in skin folds
  - Hypoglycemia, hyponatremia and hyperkalemia
- **First trimester**
  - **Hyperemesis**
  - **Infection**
- Third Trimester
  - Delivery, vaginal or CS
- Hormonal test
  - **Salivary free cortisol**
- Other
  - Adrenal antibodies, for autoimmune disease
  - ACTH stimulation test, caution on increased adrenal response in pregnancy





# AI in Pregnancy: *Management*

- In current case, if **suspicious for AI**, increase **HC dose**
- **For replacement:**
  - HC is short-acting, does not cross placenta, 15-25 mg, BID-TID
  - Prednisolone OD, good alternative
  - Fludrocortisone, 0.05-0.1 mg/day
- **For AI**
  - HC at 40 mg has MR effect (0.1 of fludrocortisone)
  - Prednisolone, no MR effect, increase by 20-30%.

# Adrenal Crisis in Pregnancy: *Diagnosis*

- Abdominal pain, vomiting, shock
- High index of clinical suspicion.
  - Severe vomiting, disrupted HC tabs absorption
- Adrenal hemorrhage and thrombosis, sepsis, labor, surgery





## Adrenal Crisis in Pregnancy: *Management*

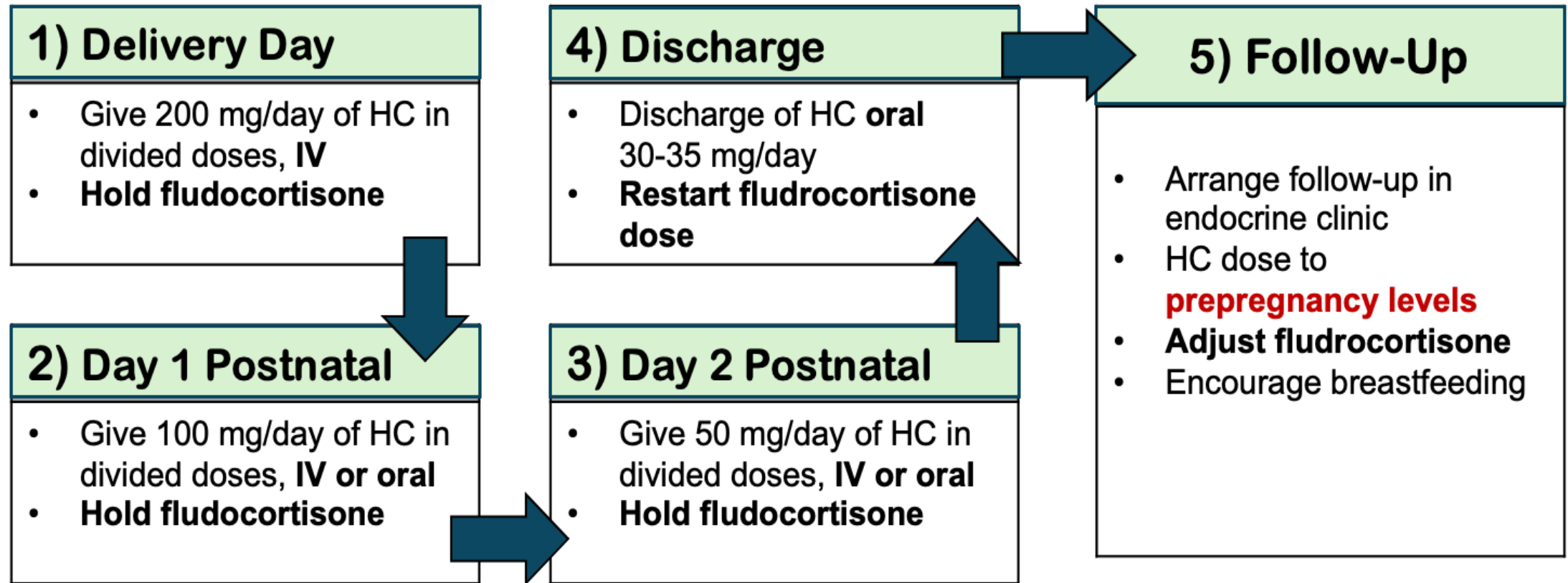
- **PREVENTIVE:** From Replacement HC oral 5-20 mg/day to intrapartum, 50-100 mg IV q 8 hrs x 24 hrs
- **If in shock**
  - 2- 3 litres of 0.9% saline or 5% dextrose in 0.9%
  - HC IV at 100 mg every 6–8 hours, or as a continuous infusion of 200–300 mg in 24 hours
  - Monitor VS and electrolytes
- **Once stable**, parenteral tapered over 1–3 days; then switch to oral HC and fludrocortisone. Find and resolve cause.



**QUESTION: When will you shift to prepregnancy maintenance/replacement HC and MC doses?**

- A. Day 1 postpartum, if on a diet
- B. Upon immediate discharge
- C. Upon follow-up

# Management of Glucocorticoids and Mineralocorticoids During Delivery and in the Puerperium





## Choose the Best Answer: **What to do?**

A. The nausea and vomiting are signs of adrenal insufficiency (AI), so **outright increase the dose of hydrocortisone.**-  
**Check for source of infection, quantify magnitude of vomiting**

B. There is negative orthostatic hypotension, **so observe further. Be vigilant, do not wait!---**Fetal FGR, increased maternal morbidity and mortality

C. **Do hormonal test** to fully assess the situation. **Cautious on interpretation**





**Question: When will you shift to prepregnancy maintenance/replacement HC and MC doses?**

- A. Day 1 postpartum, if on a diet.
- B. Upon immediate discharge.
- C. Upon follow-up .



## Case 2

- 35 years old
- Obese since age 25, irregular menstruation
- (+) Infertility history
- Prediabetes, on metformin
- Now, G1P0, 12 weeks AOG
- BP 137/84, PR 82
- BMI, >95<sup>th</sup> centile for AOG
- Upper limb weakness
- Purplish striae
- Easy bruisability



## QUESTION: What is/are the significant feature/s to suspect Cushing syndrome (CS)?

- A. Gynecologic history
- B. State of prediabetes
- C. Weight history and current BMI
- D. Physical examination findings



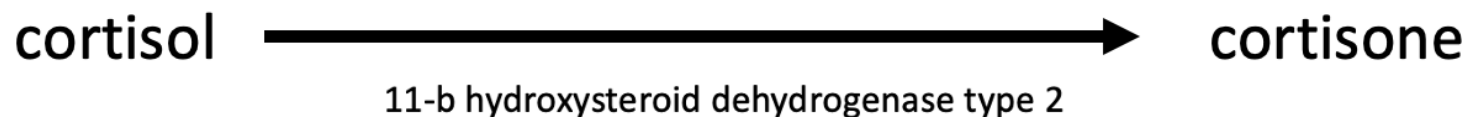
# CS in Pregnancy: *Challenges*

- Adrenal adenoma, 60% in pregnancy, **44% with CS, 263 cured CS**

	Active CS (%)	Cured CS (%)
GDM	36.9	2.3
GHTN	40.5	2.3
Preeclampsia	26.3	2.3
Fetal loss	23.6	8.5
Global fetal morbidity	33.3	4.9

# Fetal Status and Hypercortisolemia

- The fetus is relatively shielded from maternal hypercortisolism:



- Active CS leads to fetal risks:
  - Miscarriage
  - Fetal growth retardation
  - Preterm delivery
  - Stillbirth
  - Neonatal AI

# Predictors of Fetal Loss



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- Etiology of hypercortisolism, **pregnancy-induced CS**, OR 4.7
  - Publication period, 1975-1994
- Treatment during gestation, OR medical 0.25, surgical, 0.34
- Period of diagnosis of CS, predictor of overall fetal morbidity/mortality.
- Both **medical treatment and surgery** during pregnancy appeared to be **protective** in avoiding fetal loss.
- **Timely diagnosis is a big challenge.**
- **Early treatment of CS increases live birth rate.**



# Pregnancy-Associated CS

- Definition
  - CD onset during gestation or within 12 months after delivery or abortion
- Pathophysiology
  - **Increased estrogen (100-fold)----**stimulates pituitary angiogenesis, mitogenesis, and adenohypophyseal hormone secretion.
  - **Placental CRH----**activates HPA axis, desensitizes negative feedback----surge of plasma ACTH and cortisol----**pituitary tumorigenesis.**

# Features of Pregnancy-Associated CD



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- Incidence (N=70): 27.1%
- Timing of diagnosis:  $2.7 \pm 3.4$  yrs postpartum
- **Remission rate: 89.5%**
- Common: HTN, severe DM, LBW babies
- Rate of abortion and pre-term birth: 26.3, 28.6%, respectively.

## Clues to Pregnancy-Associated CS

- High degree of clinical suspicion for CD in the peripartum period.
- Patients with symptoms suspicious for CD throughout pregnancy and after childbirth:
  - Early-onset hypertension
  - Severe hyperglycemia
  - Persistent weight gain
- Other reported maternal complications
  - Wound infection
  - Heart failure
  - Psychiatric disorders
  - Maternal death
- Should be carefully diagnosed and closely monitored.



**QUESTION:** How will you **screen/diagnose** CS in pregnancy?

- A. Clinical features, 1 mg dex/8 mg dex suppression
- B. Diurnal plasma cortisol, UFC/8 mg dex suppression
- C. Late night salivary cortisol, UFC/8 mg dex suppression

# CS in Pregnancy: *Clinical Diagnosis*



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- Overlapping pregnancy-associated features with CS vs. non-CS associated:
  - Weight gain, hypertension, striae, muscle, fatigue, and glucose intolerance.
- CS-specific features:
  - Proximal myopathy
  - Easy bruising
  - Early onset hypertension in pregnancy
  - Presence of red or purple striae (instead of pale striae of normal pregnancy)
  - Hirsutism, osteopenia/osteoporosis-induced fractures

# CS in Pregnancy: *Hormonal Diagnosis*

- **Screening:** Midnight plasma cortisol level, diurnal variation is maintained though higher than nonpregnant.
- **Diagnosis:** Late-night salivary cortisol and UFC, >3x upper limit of normal values.
  - **Thresholds**, 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> trimester: <6.9, <7.2, and <9.1 nmol/L, respectively, depends on assay.
- One (1 mg) dex suppression- false positive owing to pregnancy-induced hypercortisolism, placental ACTH is not suppressed by dexamethasone.
- **Eight (8) mg dex suppression- Cushing disease if >4.4 pmol/L.**





**QUESTION: How will you **manage** CS in pregnancy?**

A. None, until postpartum

B. Medical

C. Surgical

# CS in Pregnancy: *Surgical Management*

- Second trimester
  - Laparoscopic unilateral adrenalectomy and trans-sphenoidal surgery
  - Bilateral adrenalectomy for refractory cases
- Manage AI with adequate HC replacement therapy
  - Important in the intrapartum and immediate postpartum period

# CS in Pregnancy: *Medical Management*

- **Medical treatment**
  - Second-line option
  - If not fit or suitable for surgery.
- **Metyrapone**, steroidogenesis inhibitor
  - Increases the risk of hypertension through the accumulation of MC precursors
- **Ketoconazole and Mitotane**
  - Teratogenic
- **Cabergoline**
  - In pituitary cushing

## Optimal Pregnancy Outcome in CS

- **Good control** of gestational hypertension, DM
- Prompt assessment and management of **preterm labour**.
- **Vaginal delivery** is encouraged, because of poor wound healing.



## QUESTION: What is/are the significant feature/s to suspect Cushing syndrome (CS)?

- A. Gynecologic history
- B. State of prediabetes
- C. Weight history and current BMI
- D. Physical examination findings**



**QUESTION: How will you screen/diagnose CS in pregnancy?**

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**QUESTION:** How will you **manage** CS in pregnancy?

A. None, until postpartum

**B. Medical**

**C. Surgical**



## Case 3 ( a 22-yr old Case Report)

- 38 years old
- One (1) year history of HTN
- G2P0, miscarriage on first
- HTN on 2<sup>nd</sup> pregnancy, metoprolol 50 mg/day
- 12-13 wks AOG, endo referral
- Severe headache, muscle weakness
- BP: 160/100
- Serum K, 1.9 mmol/L
- **Admitted:**
  - **Plasma aldo, 5,420 pmol/L** (NR 145-445)
  - **PRA: 13.7 ng/mL/hr** (NR 0.15-2.33)
- Normal creatinine
- **Diagnosis: Primary Aldosteronism (PA)**



## Case 3: *Clinical Course (1)*

- **Treatment**

- IV Hydralazine, oral nifedipine, metoprolol
- K supplement
- **Spironolactone tab, 300 mg/day**

- **4<sup>th</sup> Hospital Day**

- Serum K - 4.1 mmol/L
- BP: 110-130/60-80

- **AT 38 wks AOG, cesarean section**

- Live, normal baby girl
- Apgar 8,9,9

- **6 wks postpartum**

- Plasma aldo postpartum remained high
- PRA, low normal
- CT scan, negative



## Case 3: *Clinical Course (2)*

- **18 mos postpartum**

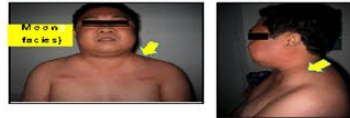
- **BAVS**- localized lesion on the **right**
- Unilateral adrenalectomy, right
- 12 hrs postop, normal BP w/ no anti-HTN meds
- Patho confirmed **adrenal adenoma**

- **19 mos postpartum**

- Normal BP and serum potassium with **no meds**

# Pathophysiology of Hypertension

## Cushing



## Striae



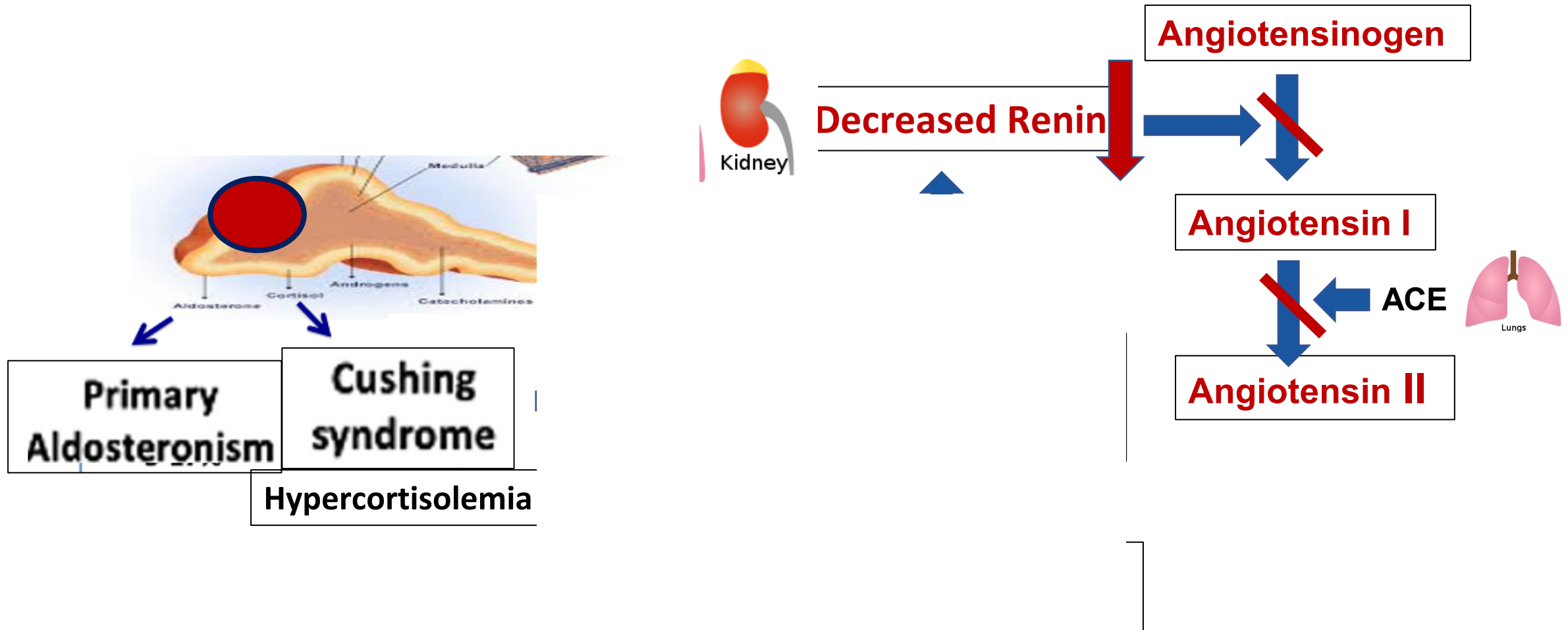
Easy bruisability

## Aldosteronism



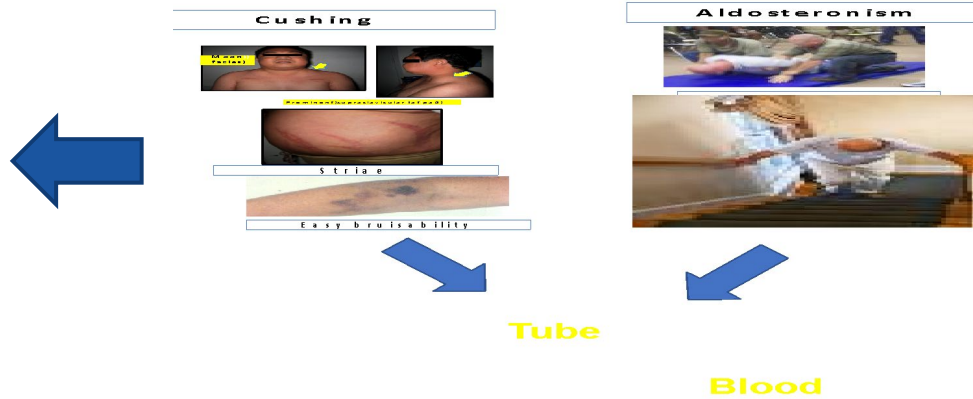
Increased volume

# Approach to BP Control



# Approach to BP Control

**Anti-adrenal**  
**Ketoconazole**



**Increased volume**

**suppressed Renin-Angiotensin System (NO SARTANS, NO ACEs)**

**Give calcium channel blocker**

**Spironolactone:**

- To block effect of aldo/cortisol to mineralocorticoid receptor
  - Diuretic

# Approach to Hypokalemia



**K= Potassium**

- Spironolactone
- Potassium supplement





# PA in Pregnancy

- PA prevalence in pregnancy, 0.6-0.8%, 50 cases in literature.
- Increase in renin activity
  - 4-fold in the first 8 weeks of gestation
  - 7-fold in the third trimester
- Increase in plasma aldosterone
  - 3 to 8-fold in 1<sup>st</sup> and 2<sup>nd</sup> trimester
  - Plateau, in 3<sup>rd</sup> trimester
- **Progesterone antagonizes the RAAS** and reduces urinary potassium excretion
  - Pregnant women are usually **normotensive and normokalemic**.



## Question: When will you suspect PA in pregnancy?

- A. All hypertensive pregnant patients
- B. Hypertensive patients with hypokalemia and resistant hypertension

# PA in Pregnancy: *Report of 40 cases*

## • Clinical features:

- 81%, HTN for the first time in pregnancy
- 19%, previous HTN, not screened for PA
- **68%, hypok**
- 19% HTN controlled, 32% resistant HTN

## • Clinical course:

- 23% developed preeclampsia,
- **61% induced vaginal delivery**
- **44% CS**
- 9.4% stillbirth

## • Treatment:

- Calcium channel blockers, beta-blockers, and alpha methyl dopa.
- **19.4%, spironolactone, highest 500 mg/day**
- 16.1%, adrenalectomy



# PA in Pregnancy: *Diagnosis*

- Before 20 weeks AOG, **resistant HTN, hypokalemia**
- High ARR
- Saline infusion, not recommended
- **MRI, BAVS, after delivery**

Funder et al, J Clin Endocrinol Metab. 2016;101(5):1889–1916, Kamoun et al, Am J Med Sci 2014;347:64–73,, Rossi et al, Hypertension 2014;63:151–60, Riester and Reincke. Eur J Endocrinol 2015;172:R23–30.



# Question: How will you treat PA in pregnancy?

A. Medical

B. Surgical

C. Both



# PA in Pregnancy: *Treatment*

- Control of BP, alpha-methyldopa, labetolol, CCB
- **Spironolactone, feminization (?), FGR**
- Eplerenone, non teratogenic
- Thiazides, amiloride, 2<sup>nd</sup> to 3<sup>rd</sup> trimester
- Unilateral adrenalectomy, second trimester, high fetal morbidity and mortality

# Spironolactone: *Issue on fetal feminization*

## Cases of human males exposed to spironolactone in utero

Case no.	Maximum daily dose, mg	Results
1	400	Normal genitals at birth and puberty
2	400	Normal genitals at birth
3	200	Normal genitals at birth
4	50	Normal genitals at birth
5	25	Normal genitals at birth

US FDA approved, 25-200mg/day



# Guide to Diagnose and Manage PA in Pregnancy

**HTN + Hypokalemia**

**High Aldo, low PRA, high ARR**

**CBB, betablocker,  
K supplement, spironolactone**

**Early delivery, CS**

**Postpartum, localize PA and  
remove**



# Case 4

- 27 years old
  - HTN at age 23, nonobese, nonsmoker, non-cushingoid
  - 14 weeks AOG
  - Presenting as “preeclampsia”
  - BP: 180/110, no edema
  - FH, kidney stones
- Work-up:
    - 2dECHO, septal dyskinesia
    - Serum aldo, PRA, normal
    - Urine, (-) protein
    - 24-hr urine metanephrines, 3x normal high

# Red Flags

- 27 years old
- HTN at age **23, nonobese, nonsmoker**, non-cushingoid
- **14 weeks AOG**
- Presenting as “**preeclampsia**”
- **BP: 180/110, no edema**
- **FH, kidney stones**
- Work-up:
  - 2dECHO, septal **dyskinesia**
  - Serum aldo, PRA, normal
  - **Urine, (-) protein**
- **Diagnosis**
  - **24-hr urine metanephrines, 3x normal high**

# Pheochromocytoma/Paraganglioma (PPGL) in Pregnancy

- Prevalence in pregnancy of PPGL 1 in 15 000 to 1 in 54 000 pregnancies
- The clinical presentation of PPGL during pregnancy is similar to that in nonpregnant women- HTN, headache, palpitations
- Most patients become **symptomatic with increasing gestation**, most likely because of **mechanical factors from the growing uterus and fetal movements**.



## Dramatic clinical presentations, laboratory and imaging findings and clinical outcome of patients with unsuspecting pheochromocytoma

Signs and symptoms	Headache, agitations, diaphoresis, nausea, vomiting Acute coronary syndrome Severe congestive heart failure Arrhythmia
Laboratory	Elevated creatine kinase Normal to elevated troponin
Clinical outcome	Resolution of signs and symptoms after adrenalectomy Normalized LV function and ejection fraction Persistent systolic and diastolic impairment Death

# Paraganglioma in Pregnancy: A Review

- Estimated prevalence, 0.0007%
- N=8 pregnancies

<b>Mortality (%)</b>	<b>Paraganglioma</b>	<b>Pheochromocytoma</b>
Maternal	3.6	9.8
Fetal	12	16

## PPGL on Pregnancy and Fetal Outcomes

- **High maternal catecholamines---** uteroplacental vasoconstriction---FGR, fetal hypoxia, fetal death
- **Paroxysmal maternal BP elevation/hypotension---** placental abruption, intrauterine hypoxia---adverse fetal outcomes
- **Decline in fetal mortality**
  - 1960s, 50%
  - 1990s, 25%
  - Last decade, 9.5%
  - If PPGL diagnosed **antenatally, 7%, missed diagnosis, 17%**



**Question: How will you treat PPGL in pregnancy?**

A. Medical

B. Surgical

C. Both

## Catecholamines on the Various Receptors (adrenergic, dopaminergic) and Their Common Manifestations in Pheochromocytoma (1)

Target organ system	Receptor types	Sympathetic action	Common manifestations in pheochromocytoma
Skin and mucosa	$\alpha 1, \alpha 2$	Vasoconstriction, localized secretion of sweat glands	Pallor, diaphoresis
Peripheral vascular	$\alpha 1, \alpha 2, \beta 2$	Vasoconstriction $\alpha 1, \alpha 2$ Vasodilation $\beta 2$	Hypertension
Orthostatic hypotension			
Brain	$\alpha 1, D1$	Vasoconstriction	Headache
Heart	$\beta 1, \beta 2, D1$	Increase in heart rate, contractility, automaticity, conduction velocity	Palpitations, tachycardia, angina



## Catecholamines on the Various Receptors (adrenergic, dopaminergic) and Their Common Manifestations in Pheochromocytoma (2)

Target organ system	Receptor types	Sympathetic action	Common manifestations in pheochromocytoma
Lungs	$\alpha 1, \beta 2$	Pulmonary arteriole vasoconstriction, tracheal and bronchial muscle relaxation	Dyspnea
Gastrointestinal	$\alpha 1, \alpha 2, \beta 2$	Decrease gastrointestinal motility and secretion, constricts sphincters, increases liver glycogenolysis and gluconeogenesis, increases pancreatic release of insulin and glucagon	Nausea, abdominal pain, constipation, hyperglycemia
Kidneys	$\beta 1$	Increase renin secretion	Hypertension
Adipocytes	$\beta 1, \beta 3$	Increase lipolysis	Weight loss



## PPGL in Pregnancy: *Diagnosis and Management (1)*

- Similar in nonpregnant patients.
- **For high BP**, phenoxybenzamine, doxazocin, betablockers, CCB
  - Check neonatal hypotension, respiratory depression
- **Biochemical tests**, plasma and 24 hr urine metanephrines, 100% sensitivity, 98% specificity
  - Stop phenoxybenzamine, clonidine, reserpine, levodopa, antidepressants

## PPGL in Pregnancy: *Diagnosis and Management (2)*

- **MRI**, imaging during pregnancy, MIBG/PET in postpartum
- **Adrenalectomy**, before 24 weeks AOG or postpartum
- **Mode of delivery**, well-timed/planned CS is preferred



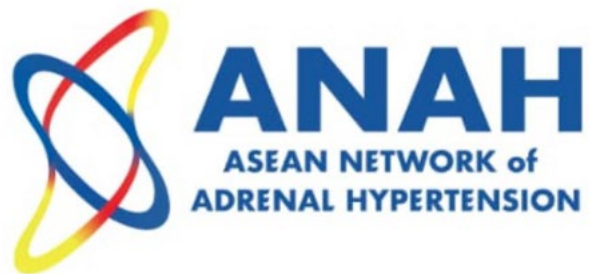
## Overall Summary and Insight (1)

- Reports of **adrenal disorders (AI, CS, PA, PPGL) in pregnancy** is limited, therefore, their rarity could be relative.
- We have to **increase awareness** of these entities, for favorable outcomes for both the mother and the baby.
- **Early diagnosis** during the antepartum period with **optimal medical management** (well-adjusted HC replacement in AI, control of BP and other comorbidities in CS, PA and PPGL) **decrease maternal and fetal morbidity and mortality**.



## Overall Summary and Insight (2)

- **Close fetal monitoring** must be done to alleviate fetal adverse effects of drugs.
- **Well-timed and planned cesarean section mode** of delivery for PA and PPGL, and vaginal for CS lead to favorable maternal and fetal outcomes.
- For more **definitive approaches for diagnosis and treatment** (CS, PA, and PPGL), these could be done in the **postpartum period**.



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EXPERTS IN ADRENAL CONDITIONS

*Transforming health outcomes for  
individuals with adrenal hypertension  
and related conditions*

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