LAB WORK TAKE TWO:

EYE CAN TEST THAT

MEGHAN ELKINS, OD, FAAO
LAST UPDATED: 1/21/2020

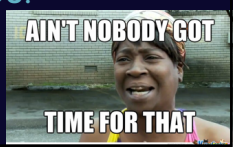
1

NO DISCLOSURES

2

CAVEAT

THIS LECTURE DOES NOT REVIEW ALL LABS AVAILABLE TO YOU.



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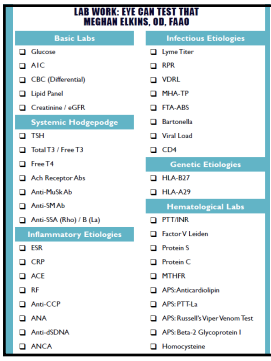
CAVEAT

THIS LECTURE SERVES AS AN INTRODUCTION AND REVIEW.

NOTE: WE WILL NOT BE GOING OVER CASES WITH THIS LECTURE.

4



LAB WORK: EYE CAN TEST THAT
MEGHAN ELKINS, OD, FAAO

Basic Labs
- ❑ Glucose
- ❑ A1C
- ❑ CBC (Differential)
- ❑ Lipid Panel
- ❑ Creatinine / eGFR

Systemic Hodgepodge
- ❑ TSH
- ❑ Total T3 / Free T3
- ❑ Free T4
- ❑ Ach Receptor Abs
- ❑ Anti-MuSk Ab
- ❑ Anti-SM Ab
- ❑ Anti-SSA (Rho) / B (La)

Inflammatory Etiologies
- ❑ ESR
- ❑ CRP
- ❑ ACE
- ❑ RF
- ❑ Anti-CCP
- ❑ ANA
- ❑ Anti-dsDNA
- ❑ ANCA

Infectious Etiologies
- ❑ Lyme Titer
- ❑ RPR
- ❑ VDRL
- ❑ MHA-TP
- ❑ FTA-ABS
- ❑ Bartonella
- ❑ Viral Load
- ❑ CD4

Genetic Etiologies
- ❑ HLA-B27
- ❑ HLA-A29

Hematological Labs
- ❑ PTT/INR
- ❑ Factor V Leiden
- ❑ Protein S
- ❑ Protein C
- ❑ MTHFR
- ❑ APS: Anticardiolipin
- ❑ APS: PTT-La
- ❑ APS: Russell's Viper Venom Test
- ❑ APS: Beta-2 Glycoprotein I
- ❑ Homocysteine

OVERVIEW

Checklist for lab orders!

Make your own or start with this one and add / remove as needed.

5

INTRODUCTION

1. WHEN IS LAB TESTING APPROPRIATE?
2. WHAT TO WRITE ON AN ORDER REQUEST?
3. WHERE TO ORDER LABS?

6

WHEN IS LAB TESTING APPROPRIATE?

1. Will your treatment strategy change if you know the etiology?
2. Is your management plan not resolving the patient's issues?
3. Will the patient die if you happen to miss a diagnosis?
4. Will you get sued if you *don't* order a specific test?

7

WHAT TO WRITE ON AN ORDER REQUEST?

- Write it on a prescription pad!

- What lab(s) you want
- Tentative diagnosis
- No preferred date required

8

WHERE DO YOU ORDER YOUR LABS?

- Whatever lab you or the patient prefers!

9

MAIN OBJECTIVES

GLUCOSE
HbA1C
CBC
LIPID PANEL
KIDNEY FX
ANA

SENSITIVITY
SPECIFICITY
IgG
IgM
DILUTIONS

10

THE BORING STUFF

AKA: BASIC LABS ALL CLINICIANS SHOULD UNDERSTAND

GLUCOSE
HBA1C
CBC W/ DIFFERENTIAL
LIPID PANEL
KIDNEY FX

11

DIABETIC LABS

- Fingerstick or serum levels
- Many practices choose to have glucometer handy in-office

GLUCOSE	HGBA1C
70 – 110	4.2 – 5.8

12

WHY DO BLOOD SUGAR LEVELS RISE?

- You eat "something sweet"
- Sugar gets broken down and enters blood stream
- Brain signals pancreas to release more insulin
- Insulin tells all the cells to use the sugar up
- The cells are happy!
- Blood sugar levels normalize

13

WHY DO BLOOD SUGAR LEVELS RISE?

- Eating lots of sweets / carbohydrates
- Increased artificial sweetener consumption
- Insulin resistance
- Liver damage (glucagon)
- Increased inflammation
- Increased stress / cortisol
- Etc, etc

14

DIABETIC LABS

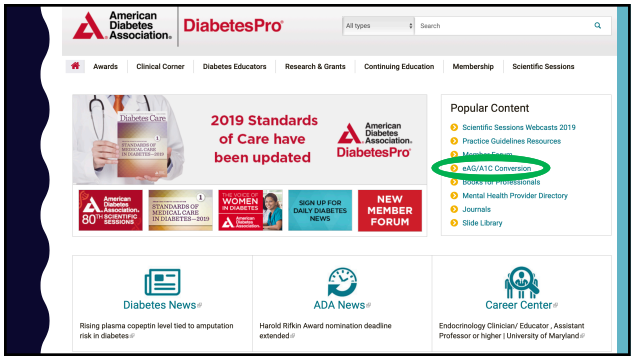
ESTIMATED AVERAGE GLUCOSE

eAG = 28.7 x A1C – 46.7

A1C	eAG
6.5	140
7	154
7.5	169
8	183
8.5	197
9	212
9.5	226
10	240

Calculator:
https://professional.diabetes.org/diapro/glucose_calc

15



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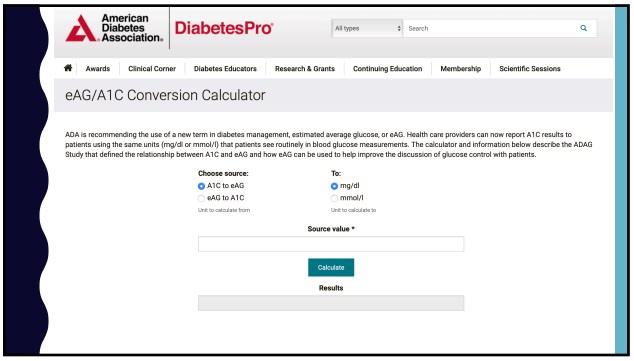

17

CBC: COMPLETE BLOOD COUNT

- Components:
  - –Red Blood Cells
  - –Platelets
  - –White Blood Cells

18

CBC: COMPLETE BLOOD COUNT

- How to use the CBC:
  - –Anemia status (RBCs and platelets)
  - –Disease status (WBCs)

19

CBC

Test Name	Result	Units	Range
WBC	6.0	K/cmm	5.0 - 10.0
RBC	4.37L	M/uL	4.70 - 6.10
HGB	14.5	g/dL	14.0 - 18.0
HCT	42.1	%	42.0 - 52.0
PLT	196	K/cmm	140 - 440
MCV	96.3H	fL	80.0 - 94.0
MCH	33.2		27.0 - 35.0
MCHC	34.4	g/dL	31.5 - 36.5
RDW	12.1	%	11.5 - 14.5
MPV	10.4	fL	7.2 - 11.1

20

CBC: EVALUATION OF RED BLOOD CELLS

- **Red Blood Cells:** actual number
- **Hemoglobin:** total amount of oxygen-carrying protein in the blood
- **Hematocrit:** % total blood volume that contains RBCs

Test Name	Result	Units	Range
WBC	6.0	K/cmm	5.0 - 10.0
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RDW	12.1	%	11.5 - 14.5
MPV	10.4	fL	7.2 - 11.1

21

RBCs

- **Red Blood Cell Indices**
  - –**Mean Corpuscular Volume:** measurement of average size of single RBC
  - –**Mean Corpuscular Hemoglobin:** calculated average amount Hgb inside single RBC

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WBC	6.0	K/cmm	5.0 - 10.0
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22

RBCs

- **Red Blood Cell Indices**
  - –**Mean Corpuscular Hemoglobin Concentration:** calculated average Hgb concentration inside single RBC
  - –**Red Cell Distribution:** calculation of RBC size variation

Test Name	Result	Units	Range
WBC	6.0	K/cmm	5.0 - 10.0
RBC	4.37L	M/uL	4.70 - 6.10
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23

PLATELETS

- **Platelets:** number of platelets in blood sample
- **Mean Platelet Volume:** calculated average platelet size

Test Name	Result	Units	Range
WBC	6.0	K/cmm	5.0 - 10.0
RBC	4.37L	M/uL	4.70 - 6.10
HGB	14.5	g/dL	14.0 - 18.0
HCT	42.1	%	42.0 - 52.0
PLT	196	K/cmm	140 - 440
MCV	96.3H	fL	80.0 - 94.0
MCH	33.2		27.0 - 35.0
MCHC	34.4	g/dL	31.5 - 36.5
RDW	12.1	%	11.5 - 14.5
MPV	10.4	fL	7.2 - 11.1

24

ANEMIA: THE MOST COMMON BLOOD DISORDER

- Description of decreased hemoglobin
- Categorized in two ways:
  - –Kinetic approach: "why"
  - –Morphological approach: "what"

25

KINETIC APPROACH

"Why"	Decreased RBC production
	Increased RBC destruction
	Blood loss
Examples:	Aplastic anemia
	Hemolytic anemia
	Iron deficiency anemia
	Hospital-acquired anemia

26

MORPHOLOGICAL APPROACH

"What"	MCV
	MCH
Examples:	Microcytic
	Normocytic
	Macrocytic

27

WHAT ELSE DOES THE CBC TELL US?

- Look at the White Blood Cell results
- Examples
  - –Atypical retinopathy patterns
  - –Papilledema

Test Name	Result	Units	Range
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28

DIFFERENTIAL

- type and amount of 5 WBC types

Test Name	Result	Units	Range
ABSOLUTE NEUTROPHIL COUNT	3.53	K/cmm	1.90 - 8.00
ABSOLUTE LYMPH COUNT	1.62	K/cmm	1.50 - 4.00
NEUTROPHIL %	59.0	%	40.0 - 74.0
LYMPH %	27.0	%	19.6 - 52.7
MONO %	9.0	%	3.4 - 10.0
EOSINOPHIL %	4.5	%	0.0 - 7.0
BASOPHIL %	0.3	%	0.0 - 2.0
ABSOLUTE MONO COUNT	0.54	K/uL	0.30 - 0.90
ABSOLUTE EOSIN	0.27	K/uL	0.00 - 0.50
ABSOLUTE BASO	0.02	K/uL	0.00 - 0.20
IG%	0.2	%	
AB-IMGR	0.01	K/uL	

For example: increased absolute neutrophil = infection

29

WBC-SPECIFIC CLASSIFICATION

Low WBC	Aplastic anemia
	Bone marrow suppression
High WBC	Infection
	Inflammation
	Hematologic malignancy

Steroids!

30

LIPID PANEL

- **Measured Values:**
  - –Total Cholesterol
  - –Triglycerides
  - –HDL: "good" cholesterol
- **Calculated Values:**
  - –VLDL = TGs ÷ 5
  - –LDL: "bad" cholesterol
  - –Cholesterol / HDL Ratio

Test Name	Result	Units	Range
L-CHOLESTEROL	170	mg/dL	Ref: <=200
TRIGLYCERIDE	109	mg/dL	30 - 170
HDL	46	mg/dL	30 - 70
VLDL	22	mg/dL	6 - 34
LDL-CHOL CALCULATION	102H	mg/dL	50 - 100
CHOL/HDL RATIO	3.7		

31

LIPID PANEL

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VLDL	22	mg/dL	6 - 34
LDL-CHOL CALCULATION	102H	mg/dL	50 - 100
CHOL/HDL RATIO	3.7		

- HDL: the "good" cholesterol
  - –Higher numbers = decreased risk for cardiovascular disease
  - –Women generally need higher numbers than men to reduce risk

32

LIPID PANEL

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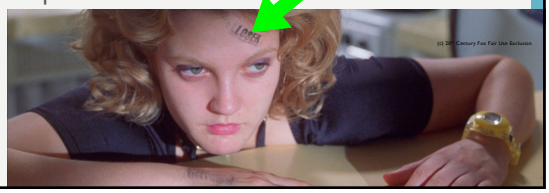
CHOL/HDL RATIO	3.7		

- LDL: the "bad" cholesterol
  - –Optimal



33

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CHOL/HDL RATIO	3.7		

- Triglycerides (Fasting)
  - –Desirable: = < 150
  - –High = > 200
  - –New thought: non-fasting could be a better representation of daily status
  - –Ocular connection: lipemia retinalis!
    - TGs > 1000

34

LIPID PANEL

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LDL-CHOL CALCULATION	102H	mg/dL	50 - 100
CHOL/HDL RATIO	3.7		

- Cholesterol / HDL Ratio
  - –Risk prevention calculation
  - –Higher ratios indicate lower "good" cholesterol content of blood sample
  - –Higher ratios = BAD
  - –Optimum Ratio = ≤3.5

Total	HDL	Ratio
170	46	3.7
164	40	4.1
220	54	4.1
230	39	5.9
226	52	4.3
233	42	5.5

35

KIDNEY FUNCTION

IMPLICATIONS

- Diamox
- Valtrex, antivirals
- Contrast
- CKD → retinopathy
- Hydroxychloroquine

LAB TESTS

- Creatinine
- BUN
- eGFR

36

CREATININE

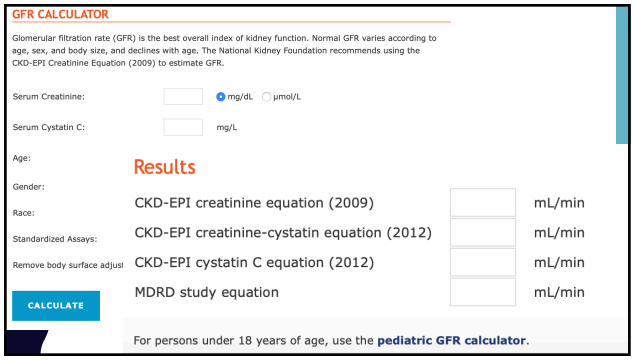
- Waste product of muscles
  - Creat*ine* → Creat*inine*
  - Dependent on muscle mass
- Almost all creatinine excreted through the kidneys
- Results
  - Blood creatinine # increasing = poor kidney function
  - Reference range: 0.5 – 1.3 mg/dL

37

GLOMERULAR FILTRATION RATE

- Calculated using formula (available on the Internet!)
- Results
  - Decreasing # is ***bad***
  - Poor kidney function: < 60
  - Units: ___ mL/min
- https://www.kidney.org/professionals/kdoqi/gfr_calculator

38



39

BLOOD UREA NITROGEN

- Protein breakdown from foods
- Waste product of liver
- Is the body ridding itself of excess nitrogen?
- Results
  - Increased = less blood to kidneys? Increased overall protein?
  - Decreased = liver disease?
  - Trend: increasing BUN = ***bad***

40

CREATININE CLEARANCE

- Sample of urine creatinine to blood creatinine
- How much creatinine is excreted in 24 hours?
- Helps determine filtering capabilities

41

KIDNEY FUNCTION

IMPLICATIONS

- Diamox
- Valtrex, antivirals
- Contrast
- CKD → retinopathy
- Hydroxychloroquine

LAB TESTS

- Creatinine
- BUN
- eGFR

42

DOSE ADJUSTMENTS - CONTRAST

- CT Scan: Creatinine
  - Omnipaque < 1.4 mg/dL*
  - Visapaque > 1.4 mg/dL*
- MRI: GFR
  - Omniscan > 60
  - Prohance 30-60
  - Contraindicated < 30

- **CIN: Contrast Induced Nephropathy**

43

DOSE ADJUSTMENTS – THE HERP

Table 1: VALTREX Dosage Recommendations for Adults With Renal Impairment

Indications	Normal Dosage	Creatinine Clearance (mL/min)		
	Regimen (Creatinine Clearance ≥ 50	30–49	10–29	< 10
Herpes zoster	1 gram every 8 hours	1 gram every 12 hours	1 gram every 24 hours	500 mg every 24 hours

Table 5 : Dosage Modification for Renal Impairment

Normal Dosage Regimen	Creatinine Clearance (mL/min/1.73m²)	Adjusted Dosage Regimen	
		Dose (mg)	Dosing Interval (hours)
200 mg every 4 hours	> 10	200	every 4 hours, 5 x daily
	0-10	200	every 12 hours
400 mg every 12 hours	> 10	400	every 12 hours
	0-10	200	every 12 hours
800 mg every 4 hours	> 25	800	Every 4 hours, 5 x daily
	10-25	800	every 8 hours
	0-10	800	every 12 hours

Rxlist.com

44

DOSE ADJUSTMENTS - DOXYCYCLINE

- None required

45

DOSE ADJUSTMENTS - DIAMOX

- Use Creatinine Clearance!
- Full dose: >50 mL/min
- Half dose: 10-50 mL/min
- No dose: < 10 mL/mind

46

DOSE ADJUSTMENTS – AREDS2

- Cannot find set recommendations
- Likely okay per clinical pharmacists

47

MAIN OBJECTIVES

GLUCOSE
HbA1C
CBC
LIPID PANEL
KIDNEY FX
ANA

SENSITIVITY
SPECIFICITY
IgG
IgM
DILUTIONS

48

SYSTEMIC HEALTH & OCULAR EFFECTS

THYROID FUNCTION
ACH RECEPTOR ANTIBODIES
SJOGREN ANTIBODIES
HLAs

49

THYROID FUNCTION PANEL

- Indications: Hypothyroidism, hyperthyroidism, etc
- Background:
  - Feedback system: Pituitary Gland → TSH → Production + Release T4 and T3 → Circulates bound to protein but small percentage "free"
  - 3 Main Labs:
    - TSH
    - Total or Free T3
    - Free T4

50

THYROID FUNCTION PANEL

TSH	T4	T3	Interpretation
High	Normal	Normal	Subclinical Hypothyroidism
High	Low	Low / Normal	Hypothyroidism
Low	Normal	Normal	Subclinical Hypothyroidism
Low	High / Normal	High / Normal	Hyperthyrodism
Low	Low / Normal	Low / Normal	Nonthyroid, i.e. pituitary hypothyroidism
Normal	High	High	Thyroid hormone resistance syndrome

51

THYROID FUNCTION PANEL

- Thyroid Antibody Labs
  - Thyroid peroxidase antibody (TPO)
  - Thyroglubulin antibody (TGAb)
  - Thyroid stimulating hormone receptor antibodies (TSHRAb)
    - Thyroid stimulating immunoglobulin (TSI)
    - Thyroid binding inhibitory immunoglobulin (TBII)
- Diagnose and monitor autoimmune thyroid disease

52

TYPICAL RESULTS

TSH	T4	T3	Interpretation	
High	Normal	Normal	Subclinical Hypothyroidism	
High	Low	Low / Normal	Hypothyroidism	SLK?
Low	Normal	Normal	Subclinical Hypothyroidism	
Low	High / Normal	High / Normal	Hyperthyrodism	Thyroid Eye Dz!
Low	Low / Normal	Low / Normal	Nonthyroid, i.e. pituitary hypothyroidism	
Normal	High	High	Thyroid hormone resistance syndrome	

53

ACETYLCHOLINE ANTIBODIES

INDICATIONS

- Wait..Why are we talking about Myasthenia right after Thyroid testing?
- …
- …
- …
- Concomittant MG with fluctuating diplopia and ptosis

54

ACETYLCHOLINE ANTIBODIES

AVAILABLE TESTS

- Acetylcholine Receptor Antibodies
  - Positive indicates autoimmune response
- Can also test for:
  - anti-MuSK AB
  - anti-striated muscle AB

55

ACETYLCHOLINE ANTIBODIES

AVAILABLE TESTS

- Acetylcholine Receptor Antibodies
  - May indicate:
    - MG
    - Thymomas
    - Small cell lung cancer
    - Autoimmune liver disease
    - Medications
  - Negative does **not** r/o MG

56

SJOGREN ANTIBODIES

INDICATIONS

- Autoimmune disorder
  - Dry Eyes
  - Dry Mouth
- Diagnosis:
  - Positive signs
  - Positive lab testing
  - Positive Salivary Gland biopsy

57

SJOGREN ANTIBODIES

AVAILABLE TESTS

- SS Antibiodies
  - Anti-SSA (Rho)
  - Anti-SSB (La)
- Also:
  - ANA (often positive)
  - RF (sometimes positive)
  - Anti-dsDNA (low levels in SS)

58

HLA-B27

INDICATIONS

- Uveitis
- Note: systemic associations
  - Ankylosing Spondylitis
  - Psoriatic Arthritis / JRA
  - Reactive Arthritis
  - IBS

RESULTS

- Positive indicates increased risk of autoimmune disease
- With recurrent uveitis an otherwise normal workup, positive HLA-B27 would indicate likely etiology
- Over 100 subtypes

59

HLA-A29

- 96% Birdshot Chorioretinopathy = A29 carrier
- Not diagnostic alone
- Studies have shown up to 61% of "Birdshot" are something else:
  - TB
  - Metastatic Dz

60

SPECIALIZED TESTING:

THE "FUN STUFF"

SUSPECTED INFLAMMATORY ETIOLOGY

- ESR
- CRP
- ACE
- RF
- Anti-CCP
- ANA
- ANCA
- AQP4

61

ERYTHROCYTE SEDIMENTATION RATE

- **NONSPECIFIC**
- Indirect measure of inflammation
- Tube of blood → 1 hour → measure plasma (clear) mm
- Different methods for testing
- Reference Range:
  - Normal is 0 – 10 for some labs*
  - What we are taught: → Men age ÷ 2; Women (age + 10) ÷ 2

62

ERYTHROCYTE SEDIMENTATION RATE

- **Elevated in:**
  - Infections
  - (Regular) arthritis
  - Autoimmune diseases
- **Diagnostic** in conjunction with CRP
  - GCA
  - Polymyalgia Rheumatica
- **Monitor disease status:** lupus

63

C-REACTIVE PROTEIN

- Acute phase reactant made by liver
- Present within hours post tissue injury, infection, or inflammation
- **NOT diagnostic alone**
  - RA, Lupus
  - GCA
- Ref Range: 0.0 – 5.0 (high is bad!)

64

ACE

- Suspected Sarcoidosis
  - 60-90% elevated ACE
  - Normal levels not exclusionary
  - Usually ordered in conjunction with CXR and PPD
  - Can biopsy visible skin lesions

65

ACE

- If clinical signs indicate sarcoidosis but laboratory testing negative:
  - Can order chest CT and/or whole-body gallium scan
  - Positive scan + elevated ACE =

    73% sensitive & 100% specific for sarcoid

66

TERMINOLOGY!

- Sensitivity
  - –True positive
  - –So if negative result → patient does not likely have the disease
- Snout →

Sensitivity rules out.

67

TERMINOLOGY!

- Specificity
  - –True negative
  - –So if positive result → patient likely has the disease
- Spin

Specificity rules in.

68

RHEUMATOID FACTOR

INDICATIONS

- Uveitis
- Scleritis

- Note
  - –negative result does not r/o RA
  - –Important to consider clinical history with interpretation

69

RHEUMATOID FACTOR

RESULTS

- Positive Test + Clinical Signs = Likely RA
- False Positives:

Sjogren's Syndrome	SLE
Sarcoid	Endocarditis
TB	Syphilis
HIV	Mono
Hepatitis	Leukemia
Multiple Myeloma	Kidney Disease

Remember This: 50% positive RF @ 6 months, 85% @ 2 years!

70

ANTI-CCP: CYCLIC CITRULINATED PEPTIDE ANTIBODY

- Positive *sooner* and in *more people* with RA
- Fewer false positives
- Anti-CCP can help predict prognosis and guide Tx

	Sensitivity %	Specificity %	Cost
RF	44-60	79-89	??
Anti-CCP Ab	65-70 39-94	96-98 81-100	???

71

ANTI-CCP: CYCLIC CITRULINATED PEPTIDE ANTIBODY

- Indications to order: early disease state
  - –No prior testing but consistent signs
  - –Negative RF but consistent signs

- Indications to NOT order:
  - –Positive RF
  - –Negative RF & inconsistent signs

72

ANA

- Indications:
  - Lupus (primary)
  - Other autoimmune disorders (secondary)
- Immunoassay (ELISA)
- Indirect Fluorescent Antibody (IFA)*
  - "Positive 1:320 dilution with homogenous pattern"
  - For example, this method is what VAMC labs use
  - Check with your local labs!

73

NOTE: DILUTIONS

- 1:320 means 1 part disease to 320 parts dilutant
- If ratio goes from 1:256 → 1:16?
  - That's good!
  - Think of it like watered down iced tea
    - The more water put into the tea…
    - The less like tea it tastes…

74

ANA

- SLE:
  - 95% positive ANA
  - ENA panel → further testing
- Drug-Induced SLE: hydralazine, isoniazid, anticonvulsants
- Sjogren Syndrome: 40-70%
- Scleroderma: 60-90%
- Negative ANA: SLE unlikely diagnosis
- Note: ANA increases with age

75

ANA

- Homogenous (diffuse)
  - SLE
  - Drug-induced lupus
  - Mixed connective tissue disease
- Speckled
  - SLE
  - Sjogren Syndrome
  - Scleroderma
  - RA
  - Mixed CT disease
  - Polymyositis
- Nucleolar
  - Scleroderma
  - Polymyositis
- Centromere Pattern (Peripheral)
  - Scleroderma
  - CREST
    - Calcinosis
    - Raynaud Syndrome
    - Esophogeal Dysmotility
    - Sclerodactyly
    - Telangiectasia

76

ANA RESULTS

```
Starting dilutions for serum specimens are 1:40.
A negative ANA test virtually rules out active systemic lupus
 erythematosis (SLE). Low titers may occur in > 30% of normal
 elderly patients. The ANA titer may not correlate with the
 clinical stage of disease, however titers >= 1:160 are
 frequently associated with active disease. The pattern of
staining may be helpful in determining a specific disease
state as noted below:
     SLE - Peripheral or homogeneous (rarely speckled)
     Rheumatoid arthritis - homogeneous
     Scleroderma - speckled or nucleolar
     CREST syndrome (variant of scleroderma)-anti-centromere
     Sjogren's Syndrome - speckled
     Mixed connective tissue disease - speckled
```

77

ANCA

- **ANCA** = **A**nti**n**eutrophil **C**ystoplasmic **A**ntibodies
- Suspected vasculitis
  - Wegener's?
  - Papilledema with prior normal investigative results
- Antibodies produced and attack proteins inside neutrophils
  - pANCA: myeloperoxidase (MPO)
  - cANCA: proteinase 3 (PR3)
- Indirect Immunofluorescence or ELISA

78

AQP4

- Neuromyelitis optica
- In the MS family
- Aquaporin-4 antibody used in conjunction with CSF testing
- AQP4= water channel protein to conduct water through cell membranes
- Sensitive & specific!

79

SPECIALIZED TESTING:

THE "FUN STUFF"

SUSPECTED INFECTIOUS ETIOLOGY

- Toxo Tiers
- Lyme Titer
- Syphilis Labs
- TB
- HIV

80

TOXO TITERS

- White-yellow lesion (active)
- Chorioretinal scar (old)
- Posterior Uveitis
  - Active
  - 90%: Most common cause of posterior uveitis
- Overlying vitreous debris (inactive)
- Lab Test:
  - Serum anti-Toxoplasma antibody titers (IgG + IgM)
  - Anterior chamber taps for toxo titers + PCR

81

NOTE: IgG & IgM

- IgG: Forever*
- IgM: Here one day, gone the next

82

TOXO TITERS – IgM

- Positive up to 2-6 weeks after initial infectious period
- Positive result is more diagnostic than IgG

83

TOXO TITERS - IgG

- Present several weeks after initial infection
- Positive results not diagnostic for Toxo due to high percentage of seropositive immunity
- Negative results more valuable for exclusionary purposes

- Wills Eye: request 1:1 dilution for test in order to find even smallest amount of antibodies
- Labtestsonline.org: request repeat testing at reference laboratory for positive IgM results
  - Note: in ocular world, treat for Toxo when fundus appearance is consistent with toxo and IgM is positive

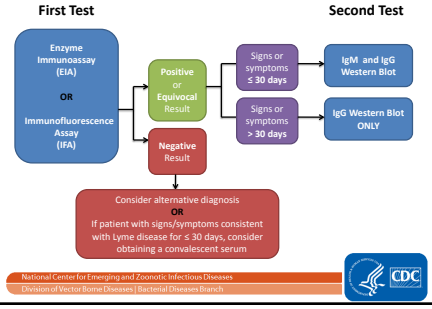
84

LYME TITERS

- Two types bacteria:
  - *Borrelia burgdorferi*
  - *Borrelia mayonii*
- Antibodies are positive = likely Lyme Disease!
  - BUT…
  - Syphilis & SLE can cause false positive
- So: Repeat testing with different method to confirm!

- Note: typically serum testing but may perform on CSF if CNS symptoms develop

85



86

LYME TITERS

IgM	IgG	Western Blot	Interpretation
+	+	+	Likely Lyme
+	-	-	Early infection or false positive
-	+	+	Late or previous infection
-	-	n/a	No infection or ABs too low to detect
-	+	-	Prior infection or false positive

87

SYPHILIS

AVAILABLE TESTS

- RPR Screen: serum
- RPR Quantification: sometimes automatically ordered if positive screen
- VDRL (RPR): serum, same as RPR screen just through VDRL lab
- VDRL (VDRL): CSF
- MHA-TP: "Test used as a confirmation for syphilis. Screen first with RPR."
- FTA-ABS: serum

88

SYPHILIS

NONTREPONEMAL ANTIBODY TESTS

- RPR Screen: screening + monitoring
- VDRL (VDRL)
- Highly sensitive but nonspecific
- False positives: pregnancy, Lyme Dz, SLE, TB, etc
- Any positive followed by Treponemal test
- Negative result post-treatment

89

SYPHILIS

TREPONEMAL ANTIBODY TESTS

- FTA-ABS:
  - 3-4 weeks post exposure
  - Especially useful for neurosyphilis (CSF)
- TP-PA: more specific than FTA-ABS
- MHA-TP: supposedly not used as often

- **Positive result for life**

90

SYPHILIS

RESULTS

- Note: for following infection status, repeat titers should be *lower*
  - Example: 1:256 → 1:16 is good!
  - Stable or increased dilution = patient not taking medication, persistent infection, or reinfection
- CSF testing needed for latent or late stage
- Direct detection through dark field microscopy or PCR can be utilized, too

91

BARTONELLA

- Positive or negative titers!

92

TUBERCULOSIS

LABORATORY

- Tuberculin Skin Test
  - Purified protein derivative (PPD)
  - Does not differentiate active vs latent TB
- Interferon Gamma Release Assay
  - Quantiferon-TBI Gold
  - Does not differentiate active vs latent TB

IMAGING

- Chest x-ray

Active Process?
Acid-Fast Bacillus (AFB)!
Sputum
Body Fluids / Tissues

93

HIV

VIRAL LOAD

- Unit: Copies/mL
- < 200 copies/mL = adequate suppression
- Undetectable ≠ no HIV

CD4 COUNT

- Measure of T-lymphocytes
- "Attack" infections
- If active HIV status → CD4 count decreased
- Normal: 500-1200 cells/mm^3
- < 200 = risk of opportunistic infection

94

TO BLEED OR NOT TO BLEED

PTT / INR
HOMOCYSTEINE
ANTICARDIOLIPIN
FACTOR V LEIDEN
PROTEIN S/C
MTHFR
*ANTIPHOSPHOLIPID ANTIBODY PANEL

95

CLOTTING LABS

(AKA: THE LABS WE ORDER ALL THE TIME BUT DON'T ACTUALLY ORDER)

- Tests:
  - PT: prothrombin time
  - PTT: partial thromboplastin time
  - INR: international normalized ratio (calculated)
- Reported in seconds.

96

PT/PTT INTERPRETATION

(AKA: WHAT YOU SHOULD DO WITH THOSE LABS YOU DON'T ACTUALLY ORDER)

PT	PTT	Etiology
Prolonged	Normal	Liver disease, decreased vitamin K, decreased or defective factor VII
Normal	Prolonged	Hemophilia A or B (decreased or defective factor VIII or IX) or factor XI deficiency, von Willebrand disease, factor XII deficiency, lupus anticoagulant
Prolonged	Prolonged	Decreased or defective factor I, II, V, or X; severe liver disease; disseminated intravascular coagulation (DIC)
Normal	Normal or sl prolonged	Normal hemostatis or mild deficiencies in factors or von Willebrand dz, needs further testing

Courtesy: labtestsonline.org PTT: The Test

97

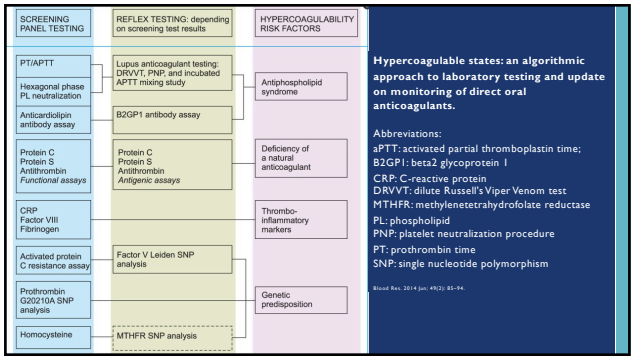
HYPERCOAGULABLE LABS

AKA: YOU'RE YOUNG AND YOU HAVE MORE THAN ONE VESSEL OCCLUSION…

- Activated protein C resistance / Factor V Leiden
- Prothrombin gene G20210A mutation
- Protein C deficiency
- Protein S deficiency
- Antithrombin III deficiency
- Hyperhomocysteinemia
- Elevated factor VIII activity
- Dysfibrinogenemia

Antiphospholipid Antibody Syndrome

98



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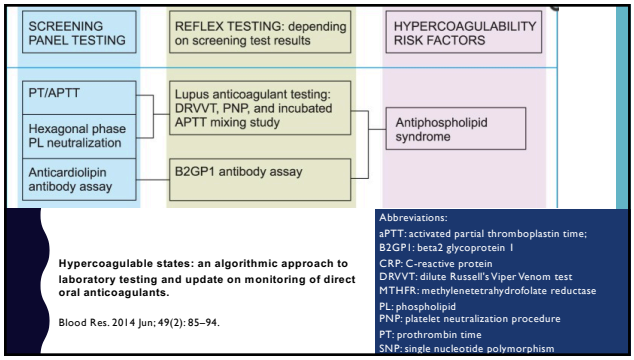

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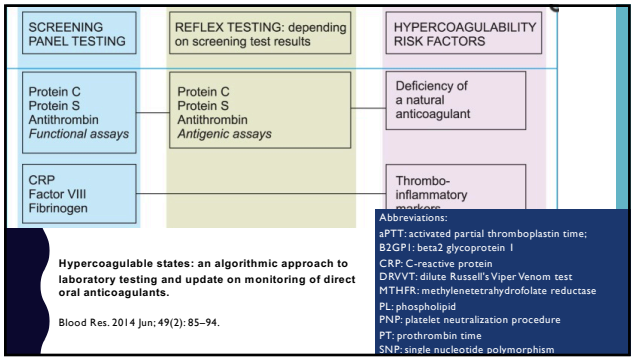

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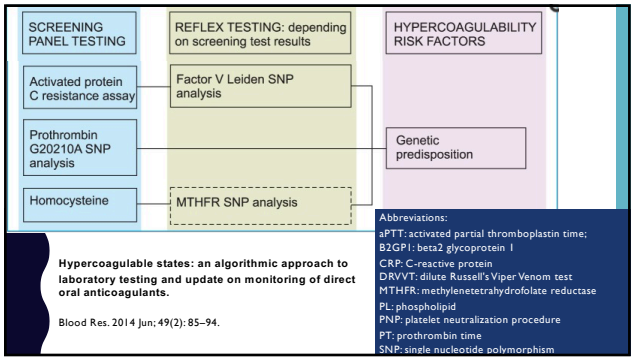

102

HYPERCOAGULABLE LABS

AKA: YOU'RE YOUNG AND YOU HAVE MORE THAN ONE VESSEL OCCLUSION…

- What I order:
  - Protein S
  - Protein C
  - Antiphospholipid Antibody Labs →
  - Homocysteine
    - Note: reference range not included in VAMC reports
    - Should be between 4.4 – 10.8
  - MTHFR

103

ANTIPHOSPHOLIPID ANTIBODY LABS

- Cardiolipin ABs:
  - IgG
  - IgM
  - IgA
- Lupus anticoagulant assays:
  - RVVT
  - LA-sensitive PTT
- Beta-2 glycoprotein I testing

- VAMC:
  - Cardiolipin Ab IgG
  - Cardiolipin Ab IgM
  - PTT-La
  - Dilute Russell Viper
    - Lupus anticoagulant
    - RVVT is "Russell's Viper Venom Test"

104

MTHFR RESULTS

```
    Specimen Collection Date: May 12, 2009@07:52
      Test name                Result    units      Ref.   range   Site Code
MTHFR, DNA ANALYSIS         Comment                                  [581]
      Eval: TEST PERFORMED AT LABORATORY CORPORATION OF AMERICA.
Comment: Result: A1298C/A1298C
        Two copies of the same mutation (A1298C/A1298C) identified
        .
        Interpretation:
        This patient's sample was analyzed for the MTHFR mutations
        C677T and A1298C. Two copies of the A1298C mutation were
        identified.  Results for the C677T mutation were negative.
        Elevated homocysteine levels have not been reported when two
        copies of the A1298C mutation have been found. The diagnosis
        of hyperhomocysteinemia can not rely on DNA testing alone
        but should take into consideration clinical findings and
        other studies, such as serum homocysteine levels.  Because
        MTHFR mutations and their associated risks are inherited,
        genetic counseling and testing of at-risk family members
        should be considered.
```

105

Final Conclusions and Considerations

1. Cost implications
2. Medical necessity vs. "going fishing"
3. Common labs checklist for clinic use
4. Make friends with a clinical pharmacist

YAY! WE'RE DONE!

106

LAB WORK: EYE CAN TEST THAT
MEGHAN ELKINS, OD, FAAO

Basic Labs
- ❑ Glucose
- ❑ A1C
- ❑ CBC (Differential)
- ❑ Lipid Panel
- ❑ Creatinine / eGFR

Systemic Hodgepodge
- ❑ TSH
- ❑ Total T3 / Free T3
- ❑ Free T4
- ❑ Ach Receptor Abs
- ❑ Anti-MuSk Ab
- ❑ Anti-SM Ab
- ❑ Anti-SSA (Rho) / B (La)

Inflammatory Etiologies
- ❑ ESR
- ❑ CRP
- ❑ ACE
- ❑ RF
- ❑ Anti-CCP
- ❑ ANA
- ❑ Anti-dSDNA
- ❑ ANCA

Infectious Etiologies
- ❑ Lyme Titer
- ❑ RPR
- ❑ VDRL
- ❑ MHA-TP
- ❑ FTA-ABS
- ❑ Bartonella
- ❑ Viral Load
- ❑ CD4

Genetic Etiologies
- ❑ HLA-B27
- ❑ HLA-A29

Hematological Labs
- ❑ PTT/INR
- ❑ Factor V Leiden
- ❑ Protein S
- ❑ Protein C
- ❑ MTHFR
- ❑ APS: Anticardiolipin
- ❑ APS: PTT-La
- ❑ APS: Russell's Viper Venom Test
- ❑ APS: Beta-2 Glycoprotein I
- ❑ Homocysteine

OVERVIEW

Checklist for lab orders!

Make your own or start with this one and add / remove as needed.

107

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- And many more

108