Casual Friday Series

Functional Blood Chemistry Series
Pt. 12: Proteins (I)

A Biogenetix Clinical Presentation

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Disclaimer

- *Information in this presentation is not intended to diagnose, treat, reverse, cure, or prevent any disease. While this presentation is based on medical literature, findings, and text, The following statements have not been evaluated by the FDA.*
- *The information provided in this presentation is for your consideration only as a practicing health care provider. Ultimately you are responsible for exercising professional judgment in the care of your own patients.*

Proteins

- Total protein
- Albumin
- Globulin
- Albumin/Globulin ratio

Total Protein

Total protein levels reflect the albumin and globulin content of blood.

Therefore, a shift in either albumin, globulin or both will alter total protein levels.

- Marker has limited clinical value as it is possible for albumin to drop, globulin to elevate, leading to a normal total protein
- Albumin/Globulin ratio helps to compensate for this however

Traditional Reference Range:

- 60-85 g/dL

Optimal Reference Range

- 6.5-7.5 g/dL

Total Protein

Elevated by:

- Chronic liver disease, dehydration, immune system issues (increased globulins)

Decreased by:

- Poor protein intake, digestion and absorption (lack of amino acids to synthesize proteins)?
  - Crohn's and ulcerative colitis
- Alcoholism and/or liver cirrhosis (poor liver function)
- Hypothyroidism

Albumin

Albumin, synthesized in the liver, is the most abundant plasma protein in the serum.

- 60% of plasma protein is albumin
- Small protein that can be lost into extravascular spaces (eg kidney dysfunction)

It has two major functions

- Binding – free fatty acids, minerals (calcium, magnesium), some hormones, medications, wastes, etc
- Osmotic gradient – primary contributor to the plasma osmotic gradient, which helps keep fluid in the circulatory system
- Also acts as a buffer and has recently been found to have antioxidant properties as well

Life span of approximately 20 days

Albumin

Transcription of albumin gene is down-regulated by:

- Cytokines (TNF, interleukins, transforming growth factor)
- Vitamin (vitamin A, B6)
- Colloid-osmotic pressure
- Amino acid deficiency

Albumin - Elevated

Cause	Reason	Additional Inquiry
Dehydration	Hemoconcentration. Albumin appears elevated but is relatively elevated due to low plasma volume.	Evaluate other markers of dehydration.

Albumin - Decreased

Cause	Reason	Additional Inquiry
Infection and/or inflammation	Albumin is a *negative acute phase reactant*, which will decrease during some infections and inflammatory processes.	Evaluate other inflammatory makers. Client history. CIRS
Liver disease	Includes alcoholism and cirrhosis. Poor liver function can lead to poor synthesis of plasma proteins, such as albumin.	Evaluate other liver markers.
Kidney disease	Due to albumin's small size, if there are issues in the glomerular filtration membrane of the kidneys, albumin can be lost in the urine.	Evaluate kidney markers.
Poor protein intake, digestion and absorption	Poor protein intake or absorption limits the amount of amino acids present for protein synthesis.	Evaluate intake and digestive function.

SPECIAL ARTICLE www.jasn.org

Reassessment of Albumin as a Nutritional Marker in Kidney Disease

The decision by nephrologists, renal dietitians, federal agencies, health care payers, large dialysis organizations, and the research community to embrace serum albumin as an important index of nutrition and clinical performance is based on numerous misconceptions. Patients with analbuminemia are not malnourished and individuals with simple malnutrition are rarely hypoalbuminemic.

Viewed in this manner, hypoalbuminemia may offer an opportunity to improve patient well-being by identifying and treating the underlying disorder.

J Am Soc Nephrol 21: 223–230, 2010. doi: 10.1681/ASN.2009020213

Kidney disease is closely associated with protein–calorie malnutrition. The World Health Organization defines malnutrition as "bad nourishment" characterized by "inadequate or excess intake of protein, energy, and micronutrients such as vitamins, and the frequent infections and disorders that result."[1] The definition implies that protein–calorie malnutrition (henceforth referred to as "malnutrition") will improve when missing nutrients are provided.

Serum albumin is the principal nutritional marker used to identify malnutrition in patients with chronic kidney disease (CKD). Through endorsements by nephrologists, renal dietitians, the research community, federal agencies, health care payers, and large dialysis organizations, it has also become a *de facto* index of clinical performance. The use of serum albumin as a nutritional and quality care marker involves the following assumptions: Serum albumin is a reliable index of malnutrition; because serum albumin is typically low in patients with CKD, these patients should be considered malnourished; replacing missing nutrients will raise low albumin levels; and, because hypoalbuminemia is strongly associated with mortality, replacing missing nutrients to raise albumin will also improve patient outcomes. This review expands on previous viewpoints[2] by critically examining these assumptions and offering an alternative vision to interpreting serum albumin.

DETERMINANTS OF SERUM ALBUMIN

General Population

Albumin is a negatively charged, water-soluble protein (molecular weight 65

ulating hepatic albumin synthesis are nutritional intake—specifically protein consumption—and illness.[5] Reduced protein consumption slows mRNA synthesis of albumin and results in lower serum levels,[3,6–11] although only in the setting of negligible dietary protein intake. Protein restriction also slows albumin degradation, although to a lesser degree than reductions in the synthesis rate.[3,12] Refeeding with amino acids or protein induces an immediate rise in albumin synthesis.[7,10]

It is also well established that albumin levels fall in patients with inflammatory disorders and other illnesses. Possible contributory mechanisms include downregulated production of albumin mRNA by the liver, leading to re-

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Correspondence: Dr. Allon Friedman, 1481 W. 10th Street-111N, Indianapolis, IN 46202. Phone: 317-988-4414; Fax: 317-988-2171; E-mail: allfried@iupui.edu

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MEN STARVE IN MINNESOTA

CONSCIENTIOUS OBJECTORS VOLUNTEER FOR STRICT HUNGER TESTS TO STUDY EUROPE'S FOOD PROBLEM

Above:
Conscientious objectors during starvation experiment.
Life magazine - July 30, 1945. Volume 19, Number 5, p. 43.
Credit: Wallace Kirkland/Time Life Pictures/Getty Images.

Left:
Dr Ancel Keys measures the chest width of James Plaugher.

SPECIAL ARTICLE www.jasn.org

Reassessment of Albumin as a Nutritional Marker in Kidney Disease

Allon N. Friedman* and Stephen Z. Fadem†‡

*Division of Nephrology, Indiana University School of Medicine, Indianapolis, Indiana; †Kidney Associates, Houston, Texas; and ‡Division of Nephrology, Baylor College of Medicine, Houston, Texas

ABSTRACT

The decision by nephrologists, renal dietitians, federal agencies, health care pay-

Albumin's widespread use as a nutritional marker is understandable in light of the desire of clinicians for a convenient, widely applicable, easily interpretable, and accurate indicator of nutritional status. Unfortunately, no such indicator exists or probably will for the foreseeable future. This does not mean that serum albumin lacks utility. Although we have demonstrated that serum albumin is not a good nutritional index in the great majority of cases, it is a powerful way to detect underlying illness; that is, the higher the serum albumin, the more intact is overall health.

kD) that is synthesized in the liver. Its

protein–calorie malnutrition (henceforth referred to as "malnutrition") will improve when missing nutrients are provided.

Serum albumin is the principal nutritional marker used to identify malnutrition in patients with chronic kidney disease (CKD). Through endorsements by nephrologists, renal dietitians, the research community, federal agencies, health care payers, and large dialysis organizations, it has also become a *de facto* index of clinical performance. The use of serum albumin as a nutritional and quality care marker involves the following as-

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General Population

Albumin is a negatively charged, water-soluble protein (molecular weight 65

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Serum albumin levels predict vascular dysfunction with paradoxical pathogenesis in healthy individuals

Mayuko Kadono[a,*], Goji Hasegawa[a], Masako Shigeta[b,c], Atsuko Nakazawa[c], Miho Ueda[c], Masahiro Yamazaki[a], Michiaki Fukui[a], Naoto Nakamura[a]

[a] Department of Endocrinology and Metabolism, Kyoto Prefectural University of Medicine, Graduate School of Medical Science, 465 Kajii-cho, Hirokoji, Kawaramachi-dori, Kamikyo-ku, Kyoto 602-8566, Japan
[b] Department of Epidemiology for Community Health and Medicine, Kyoto Prefectural University of Medicine, Graduate School of Medical Science, Kyoto, Japan

A U-shaped relationship between serum albumin and PWV was statistically significant when albumin level was treated as a continuous variable in g/dl and centered at 4.4g/dl. The highest tertile of albumin level (4.6-5.4g/dl) was associated with increased odds ratios for hyperglycemia compared to the middle tertile (4.4-4.5g/dl), whereas the lowest tertile (3.3-4.3g/dl) was associated with reduced odds ratios for hyperglycemia. The highest tertile was also associated with increased odds ratios for metabolic syndrome compared to the middle tertile, whereas the lowest tertile was associated with reduced odds ratios. Furthermore, the lowest tertile was associated with increased prevalence of inflammation.

death [4–6]. Among end-stage renal disease patients in particular, it is speculated the presence of the "malnutrition-inflammation complex syndrome" (MICS) may partly explain these paradoxical

risk factors for atherosclerosis such as obesity, insulin resistance, and metabolic syndrome, all indicators of overnutrition [10–13]. Our findings suggest that serum albumin is linked to atherogenesis through two paradoxical mechanisms, i.e. overnutrition and malnutrition-inflammation, not only in patients with renal dysfunction, but in healthy individuals. Several studies including the ARIC Study, the NHLBI Family Heart Study, and the Framingham Offspring Study, have looked at the relationship between serum

* Corresponding author. Tel.: +81 75 251 5505; fax: +81 75 252 3721.
E-mail address: mayucom@koto.kpu-m.ac.jp (M. Kadono).

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doi:10.1016/j.atherosclerosis.2009.09.006

Albumin

Traditional Reference Range:

3.5-5.5 g/dL

Optimal Reference Range:

4.3-4.7 g/dL

Globulin

Serum globulin refers to a number of different plasma proteins synthesized in different locations of the body:

- α-Globulin
  - 1 – antitrypsin, alpha 1-lipoprotein
  - 2 – ceruloplasmin, haptoglobin, thyroid binding globulin, angiotensinogen, Protein C
- β-Globulin
  - Plaminogen, sex hormone binding globulin, transferrin
- γ-Globulin
  - Immunoglobulins (antibodies)

Thus an increase or decrease in serum globulin levels can indicate a variety of changes within these subtypes

Protein electrophoresis identifies these subtypes on a blood chemistry

Globulin

- IgG >
- beta-globulin (i.e. SHBG, plasminogen, complement) >
- alpha-2-glubulin (i.e. TBG, ceruloplasmin, angiotensinogen) >
- alpha-1-globulin (i.e. antitrypsin) >
- IgA
- IgM
- IgE
- IgD

Globulin

Traditional Reference Range:

1.5-4.5 g/L

Optimal Reference Range

2.3-2.7 g/L

Globulin - Elevated

In general:

- Cancer
- Autoimmunity
- Elevated estrogen
  - Increase in SHBG and thyroid binding globulin

Globulin - Elevated

Alpha globulins

- Acute phase reactant response – infection, inflammation
- Gall bladder dysfunction (biliary cirrhosis, obstructive jaundice – check bilirubin levels)
- Ulcerative Colitis
  - “Digestive inflammation” used by other practitioners

Beta globulins

- Gall bladder dysfunction (biliary cirrhosis, obstructive jaundice – check bilirubin levels)

Gamma globulins

- Autoimmune diseases, chronic infections, some liver diseases

Globulin - Decreased

Alpha globulins

- Acute hemolytic anemia
- Nephrosis

Beta globulins

- Nephrosis

Gamma globulins

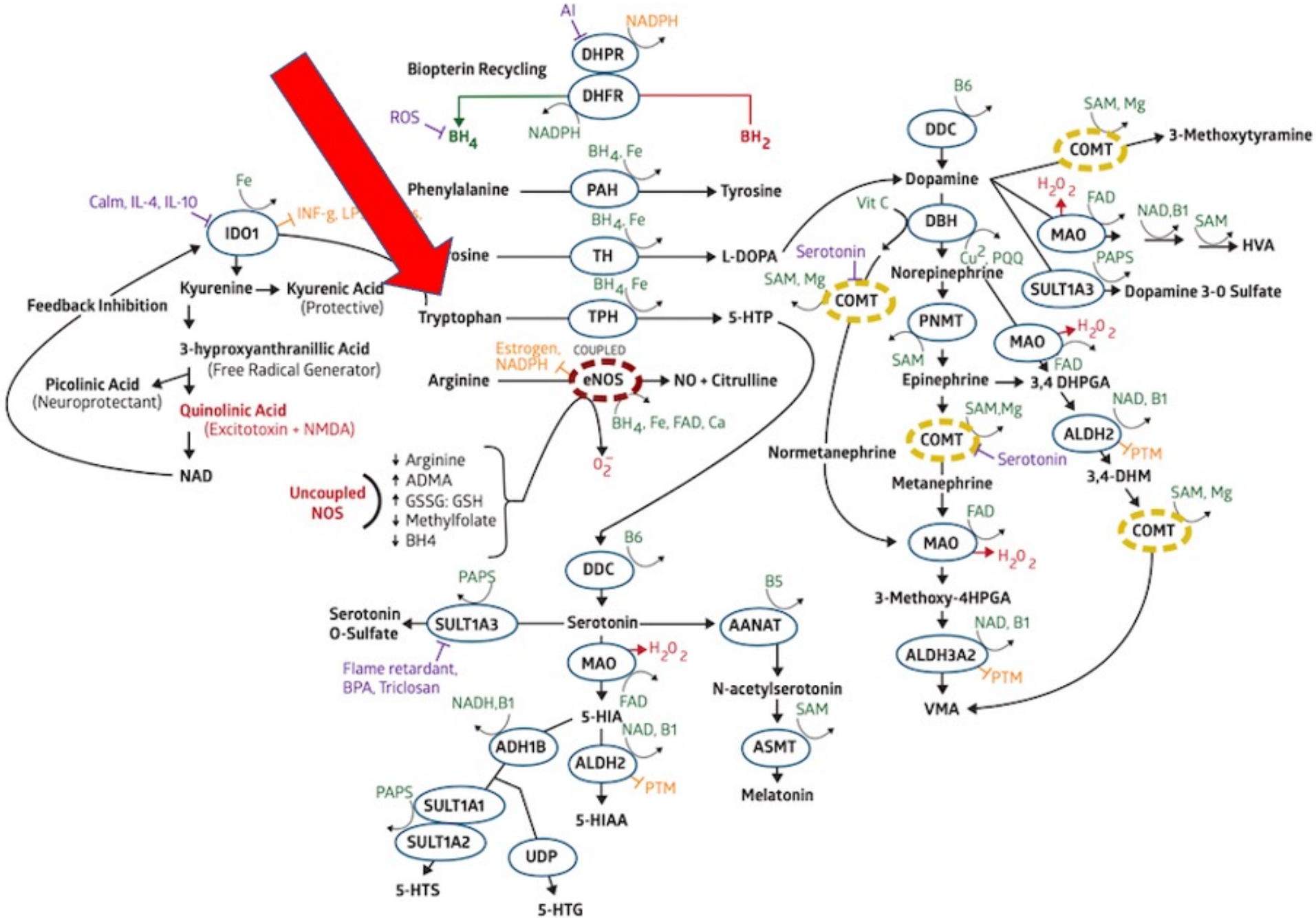
- Immune system compromise

Globulin – Quick Thought

Contain 10x as much tryptophan as albumin

If increased globulin is observed, ask patients about depressive tendencies

- As globulin synthesis increases, serum tryptophan may decrease, thus limiting the availability for serotonin synthesis


Al
NADPH
DHPR
Biopterin Recycling
DHFR
ROS
BH4
NADPH
BH2
BH4, Fe
Phenylalanine
PAH
Tyrosine
Fe
Calm, IL-4, IL-10
IDO1
INF-g, LP
BH4, Fe
TH
L-DOPA
Kyurenine
Kyurenic Acid
(Protective)
Feedback Inhibition
Tryptophan
BH4, Fe
TPH
5-HTP
3-hyproxyanthranillic Acid
(Free Radical Generator)
Picolinic Acid
(Neuroprotectant)
Quinolinic Acid
(Excitotoxin + NMDA)
NAD
Estrogen,
NADPH
COUPLED
Arginine
eNOS
NO + Citrulline
BH4, Fe, FAD, Ca
O2-
Uncoupled
NOS
↓ Arginine
↑ ADMA
↑ GSSG: GSH
↓ Methylfolate
↓ BH4
B6
DDC
Dopamine
SAM, Mg
COMT
3-Methoxytyramine
Vit C
DBH
H2O2
FAD
MAO
NAD,B1
SAM
HVA
Serotonin
Cu2, PQQ
Norepinephrine
SAM, Mg
COMT
PAPS
SULT1A3
Dopamine 3-0 Sulfate
PNMT
MAO
H2O2
SAM
FAD
Epinephrine
3,4 DHPGA
SAM,Mg
NAD, B1
COMT
ALDH2
Normetanephrine
Serotonin
PTM
Metanephrine
3,4-DHM
SAM, Mg
COMT
FAD
MAO
H2O2
3-Methoxy-4HPGA
NAD, B1
ALDH3A2
PTM
VMA
B6
DDC
PAPS
SULT1A3
Serotonin
O-Sulfate
Flame retardant,
BPA, Triclosan
Serotonin
B5
AANAT
MAO
H2O2
FAD
N-acetylserotonin
NADH,B1
5-HIA
SAM
ASMT
NAD, B1
ADH1B
ALDH2
Melatonin
PTM
PAPS
SULT1A1
SULT1A2
5-HIAA
UDP
5-HTS
5-HTG

Albumin/Globulin Ratio

Optimal Range: 1.8-2.0

- Example: Albumin of 5.0 and Globulin of 2.5 is a 2:1 ratio or 2.0

Albumin/Globulin Ratio - Elevated

High albumin/globulin ratio is either:

- Increased albumin - dehydration
- Decreased globulin - (blank food tests)
- Both

Albumin/Globulin Ratio - Decreased

Low albumin/globulin ratio is either:

- Decreased albumin
- Increased globulin
- Both

Possibly caused by liver dysfunction, chronic inflammation/infection, loss of albumin via the kidneys, autoimmunity

A note regarding Alk Phos and Protein…

Table 1. Probabilities of Assigning Samples to Either the Liver or Bone Group

Range	Probability, % Liver	Bone
γGT, U/L		
10–16	12	88
16–25	19	81
25–40	31	69
40–63	49	51
63–100	70	30
100–158	87	13
158–251	95	5
251–398	99	1
over 398	100	—
Albumin/ globulin		
0.6–1.0	80	20
1.0–1.2	71	29
1.2–1.4	56	44
1.4–1.6	35	65
1.6–1.8	14	86
1.8–2.0	6	94
over 2.0	—	100

liter. This sample was then run by the proposed method excepting that incubation times were from 0 to 40 min in a 37 °C water bath. The experiment was then repeated with use of half the amount of glutaminase called for in the proposed method. Results are shown in Figure 1. Although a 30-min incubation was used throughout this study, it can be seen that the deamination reaction is rapid and incubation time can be considerably shortened. (Zero incubation time at 37 °C refers to incubation external to the *aca*.) The *aca* requires 7 min at 37 °C to complete the ammonia assay, during which time the glutaminase reaction may still proceed. With sufficient glutaminase incorporated into a test pack, complete automation of this procedure would appear to be feasible.

Linearity. L-Glutamine standards from 0.68 to 6.80 mmol/liter, run by the

Leijnse, B., Evaluation of the DuPont *aca* ammonia procedure. *Clin. Chem.* **24**, 489 (1978).

John J. Moore,
Sylvan M. Sax
Arthur B. Blackburn, Jr.

Dept. of Pathology
The Western Pennsylvania Hospital
Pittsburgh, PA 15224

Economical Single Cellulose Acetate/Plastic Sandwich for Developing and Scanning CPK/ LDH Isoenzymes

To the Editor:

I have slightly modified isoenzyme electrophoresis by replacing one of the

in a small bin, then gently blotted before scanning in the plastic casing.

CPK. Peel off the plastic cover, blot, and air dry for a few minutes or until some protein fraction becomes visible. Place between blotters on a clean glass plate and dry in a 55 °C oven for 10 min or until dry (*3*). Cool, then observe under a longwave ultraviolet light, in a dark room.

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According to the data obtained here, if the albumin/globulin ratio is less than 1.1, there is an almost 80% chance that the liver is the predominant source of the increased alkaline phosphatase. Equally, if the albumin/globulin ratio exceeds 1.6, there is a better than 80% chance that bone is the course.

previous studies of patients without liver disease (*2*, *4*).

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air and ensure good and even soaking of the central area by causing the substrate to ooze out through the holes. Cover with another plastic sheet 1 cm away from the narrow edge of the plastic base (this helps draining). Now squeeze out excess substrate by gently pressing a squeegee across the sandwich. Repeat this procedure in the opposite direction (avoid scratching the plastic cover). Blot, trim away extra plastic, place the preparation between two blotters, then between two glass plates, and incubate, supported in a 37 °C water bath, for 30 min for CPK or 20 min for LDH. The "sandwiches" can be stacked between the glass plates. A flat weight of about 0.5 kg is placed on the top of the stack to ensure contact.

LDH. Scan immediately, while *wet* and inside the plastic (*2*). I use a Beckman R110 Densitometer 580-mm filter (*2*), slit length 0.3 mm and filter holder 0.4 cal, or visually examine the bands. If not scanned immediately, and to avoid extensive diffusion of the bands, the cellulose strip is rinsed and kept in water

serum alkaline phosphatase value, several additional enzyme analyses have been evaluated. These have included γ-glutamyltranspeptidase (γGT; EC 2.3.2.1) (*1*, *2*), 5′-nucleotidase (EC 3.1.3.5) (*3*, *4*), leucine aminopeptidase (EC 3.4.1.1), and alanine and aspartate aminotransferases (EC 2.6.1.2 and EC 2.6.1.1) (*2*). The ideal situation is that they should be normal when only the bone isoenzyme is increased in concentration and above normal when the liver isoenzyme is present in increased amounts.

On each of a series of 96 routine specimens sent to the laboratory for "alkaline phosphatase isoenzymes," the following assays were done: (*a*) polyacrylamide disc electrophoresis of alkaline phosphatase by the method of Smith et al. (*5*), (*b*) γGT at 37 °C with 3-carboxy-4-nitroanilide as substrate (*6*), and (*c*) total alkaline phosphatase by continuous-flow analysis (SMA 12/60), also at 37 °C, with phenyl phosphate as substrate.

Of the 96 samples, electrophoresis

46yo female
DM2
Depression
HBP
Fatigue

Comp. Metabolic Panel (14)

	Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲	**Glucose** [01]	**185**	**High**		mg/dL	70-99
	BUN [01]	11			mg/dL	6-24
	Creatinine [01]	0.87			mg/dL	0.57-1.00
	eGFR	83			mL/min/1.73	>59
	BUN/Creatinine Ratio	13				9-23
	Sodium [01]	137			mmol/L	134-144
	Potassium [01]	4.3			mmol/L	3.5-5.2
	Chloride [01]	102			mmol/L	96-106
	Carbon Dioxide, Total [01]	23			mmol/L	20-29
	Calcium [01]	9.2			mg/dL	8.7-10.2
	Protein, Total [01]	7.2			g/dL	6.0-8.5
▼	**Albumin** [01]	**3.7**	**Low**		g/dL	3.8-4.8

Comp. Metabolic Panel (14) (Cont.)

	Globulin, Total	3.5			g/dL	1.5-4.5
▼	**A/G Ratio**	**1.1**	**Low**			1.2-2.2
	Bilirubin, Total [01]	0.2			mg/dL	0.0-1.2
	Alkaline Phosphatase [01]	78			IU/L	44-121
	AST (SGOT) [01]	23			IU/L	0-40
	ALT (SGPT) [01]	18			IU/L	0-32

	Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
	Lipids [01]					
	Cholesterol, Total [01]	148			mg/dL	100-199
▲	**Triglycerides** [01]	**156**	**High**		mg/dL	0-149
	HDL Cholesterol [01]	41			mg/dL	>39
	VLDL Cholesterol Cal	27			mg/dL	5-40
	LDL Chol Calc (NIH)	80			mg/dL	0-99
	T. Chol/HDL Ratio	3.6			ratio	0.0-4.4
	Please Note: [01]					

46yo female
DM2
Depression
HBP
Fatigue

Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲ **Hemoglobin A1c** [01]	**7.3**	**High**		%	4.8-5.6
Estim. Avg Glu (eAG)	163			mg/dL	

Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲ **C-Peptide, Serum** [01]	**4.9**	**High**		ng/mL	1.1-4.4
C-Peptide reference interval is for fasting patients.					

Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲ **C-Reactive Protein, Cardiac** [01]	**9.24**	**High**		mg/L	0.00-3.00
Relative Risk for Future Cardiovascular Event					
Low				<1.00	
Average				1.00 - 3.00	
High				>3.00	

Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲ **Uric Acid** [01]	**7.5**	**High**		mg/dL	2.6-6.2
Therapeutic target for gout patients: <6.0					

Fibrinogen Activity

Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲ **Fibrinogen Activity** [01]	**684**	**High**		mg/dL	193-507

Ferritin

Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲ **Ferritin** [01]	**154**	**High**		ng/mL	15-150

46yo female
DM2
Depression
HBP
Fatigue

High (>95th percentile)

Mycotoxins | Environmental Toxins

TEST NAME	CURRENT RESULT	PREVIOUS RESULT	CURRENT RESULT / PREVIOUS RESULT	REFERENCE
Fumonisins B3	29.6		0 — 6.08 — 10.8	≤10.8 ng/g
Glyphosate	17.46		0 — 1.65 — 7.6	≤7.6 ug/g

Moderate (75th-95th percentile)

Mycotoxins | Heavy Metals | Environmental Toxins

TEST NAME	CURRENT RESULT	PREVIOUS RESULT	CURRENT RESULT / PREVIOUS RESULT	REFERENCE
Enniatin B1(ENN B1)	0.16		0 — 0.13 — 0.22	≤0.22 ng/g
Fumonisins B2	7.19		0 — 4.05 — 7.2	≤7.2 ng/g
Ochratoxin A (OTA)	3.99		0 — 3.83 — 6.8	≤6.8 ng/g
Tin *	2.18		0 — 1 — 3.72	≤3.72 ug/g
Bisphenol A (BPA) *	2.79		0 — 2.12 — 5.09	≤5.09 ug/g
Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP) *	15.36		0 — 8.99 — 23.4	≤23.4 ug/g

* Indicates NHANES population data reference ranges.

52 yo female
DM2
Obesity
Chronic UTI
Fatigue

Comp. Metabolic Panel (14)

	Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲	**Glucose** [01]	**147**	**High**		mg/dL	70-99
	BUN [01]	8			mg/dL	6-24
	Creatinine [01]	0.63			mg/dL	0.57-1.00
	eGFR	107			mL/min/1.73	>59
	BUN/Creatinine Ratio	13				9-23
	Sodium [01]	138			mmol/L	134-144
	Potassium [01]	4.4			mmol/L	3.5-5.2
	Chloride [01]	98			mmol/L	96-106
	Carbon Dioxide, Total [01]	28			mmol/L	20-29
	Calcium [01]	9.2			mg/dL	8.7-10.2
	Protein, Total [01]	7.7			g/dL	6.0-8.5
	Albumin [01]	4.2			g/dL	3.8-4.9
	Globulin, Total	3.5			g/dL	1.5-4.5
	A/G Ratio	1.2				1.2-2.2
	Bilirubin, Total [01]	1.0			mg/dL	0.0-1.2
▲	**Alkaline Phosphatase** [01]	**129**	**High**		IU/L	44-121
▲	**AST (SGOT)** [01]	**60**	**High**		IU/L	0-40
▲	**ALT (SGPT)** [01]	**59**	**High**		IU/L	0-32

	Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
	Lipids [01]					
	Cholesterol, Total [01]	198			mg/dL	100-199
▲	**Triglycerides** [01]	**164**	**High**		mg/dL	0-149
▼	**HDL Cholesterol** [01]	**36**	**Low**		mg/dL	>39
	VLDL Cholesterol Cal	30			mg/dL	5-40
▲	**LDL Chol Calc (NIH)**	**132**	**High**		mg/dL	0-99
▲	**T. Chol/HDL Ratio**	**5.5**	**High**		ratio	0.0-4.4

52 yo female
DM2
Obesity
Chronic UTI
Fatigue

Fibrinogen Activity

Test	Current Result and Flag	Previous Result and Date	Units	Reference Interval
Fibrinogen Activity [01]	444		mg/dL	193-507

Ferritin

Test	Current Result and Flag	Previous Result and Date	Units	Reference Interval
▲ **Ferritin** [01]	**199 High**		ng/mL	15-150

LDH

Test	Current Result and Flag	Previous Result and Date	Units	Reference Interval
▲ **LDH** [01]	**307 High**		IU/L	119-226

GGT

Test	Current Result and Flag	Previous Result and Date	Units	Reference Interval
GGT [01]	51		IU/L	0-60

C-Reactive Protein, Cardiac

Test	Current Result and Flag	Previous Result and Date	Units	Reference Interval
▲ **C-Reactive Protein, Cardiac** [01]	**19.14 High**		mg/L	0.00-3.00

Relative Risk for Future Cardiovascular Event

Low	<1.00
Average	1.00 - 3.00
High	>3.00

Test	Current Result and Flag	Previous Result and Date	Units	Reference Interval
▲ **Hemoglobin A1c** [01]	**7.0 High**		%	4.8-5.6
Please Note: [01]				

Prediabetes: 5.7 - 6.4
Diabetes: >6.4
Glycemic control for adults with diabetes: <7.0

Estim. Avg Glu (eAG)	154		mg/dL	

52 yo female
DM2
Obesity
Chronic UTI
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High (>95th percentile)

Heavy Metals | Environmental Toxins

TEST NAME	CURRENT RESULT	PREVIOUS RESULT	CURRENT RESULT / PREVIOUS RESULT	REFERENCE
Tin *	5.94		0 1 3.72	≤3.72 ug/g
3-Methylhippuric Acid (3MHA)	1138.86		0 64.8 612	≤612.83 ug/g
Dimethyldithiophosphate (DMDTP) *	8.9		0 0.67 6.12	≤6.12 ug/g
Mono-ethyl phthalate (MEtP) *	1414.08		0 94.2 541	≤541 ug/g

* Indicates NHANES population data reference ranges.

Moderate (75th-95th percentile)

Mycotoxins | Heavy Metals | Environmental Toxins

TEST NAME	CURRENT RESULT	PREVIOUS RESULT	CURRENT RESULT / PREVIOUS RESULT	REFERENCE
Ochratoxin A (OTA)	4.14		0 3.83 6.8	≤6.8 ng/g
Sterigmatocystin (STC)	0.45		0 0.3 0.53	≤0.53 ng/g
Verrucarin J	8.44		0 5.18 9.2	≤9.2 ng/g
Zearalenone (ZEN)	0.65		0 0.38 0.67	≤0.67 ng/g
Cadmium *	0.32		0 0.29 0.8	≤0.8 ug/g
Bisphenol A (BPA) *	2.32		0 2.12 5.09	≤5.09 ug/g
Ethylparaben *	30.58		0 5.41 99.3	≤99.3 ug/g

* Indicates NHANES population data reference ranges.

The Wedge Protocol