



Laboratory value in End-stage Renal Disease



Albumin

A good measure of health in dialysis patient.

Normal rang : **3.5-5.4 g/dl**

CKD Normal rang :4g/dl

The risk of **morbidity** and **mortality** increase with serum albumin levels **less than 3.5 g/dl**.

If albumin levels are **below 2.9 g/dl** fluid will leak from the blood vessels into the tissue.



Low Albumin:

- ▶ **Increase intake** of protein-rich foods: meat, fish, chicken, eggs .
- ▶ A protein **supplement** may be needed
- ▶ **Intravenous albumin** corrects short-term problems with oncotic Pressure but does not change serum albumin levels.

Why do we monitor albumin levels so closely?

➤ Hypoalbuminemia :

- 1- Higher **hospitalization** rate
- 2- **Death** in dialysis patient

What is the relationship between Albumin & CRP?

- ▶ CRP is a protein produced in response to infection.
- ▶ Elevated serum **CRP** levels are **associated** with low serum **albumin** levels in dialysis patient.
- ▶ A combination of the two factors :
 - 1- heart disease
 - 2- inflammation of the blood vessels.

NORMAL RANG: 0-3 mg/l

Other factors associated with an increase in CRP levels : surgery, bio incompatible membranes, periodontal disease, high-flux dialysis

➤ CRP levels **peak 2 to 3 days** after an acute infection and to **decrease 1 to 2 weeks** after the infection subsides.

➤ **INCREASE CRP:**

1- low serum albumin levels

2- evaluate resistance to epoetin alfa (Epogen) therapy

3- assess the course of acute bacterial infection

4- detect occult infection or chronic inflammation.

CRP levels greater **than 5 to 10 mg/l** as being indicative of inflammation.

Ferritin

- This is how iron is **stored** in the liver.
- If iron stores are low, red blood cell production is decreased.
- Male: **20-350 mcg/l**
- Female: **6-350 mcg/l**
- Normal for people on dialysis: **300-800 mcg/l with EPO**
- Normal for people on dialysis: **50 mcg/l without EPO**



Ferritin

- ▶ **Ferritin is a storage form.**
- ▶ **Stored in intestinal mucosal cells, liver, spleen & bone marrow.**
- ▶ **In the mucosal cells, ferritin is the temporary storage form of iron.**

Low Ferritin is resulted because of:

- Iron in food is not well **absorbed** .
- Most patients need an IV iron **supplement** .
- Patients should not take oral iron **at the same time** as phosphate binders.

➤ **Transferrin**

- In healthy people, about **20-40%** of available transferrin sites are used to transport iron.

Transferrin saturation is decrease with iron deficiency and increase when excess amount of iron are present , as in iron overload or poisoning.

Certain types of anemia due to **accumulated iron**:

Malnutrition(vit B12, folic acid) , Inflammation, liver disease , Nephrotic syndrome.



➤ TFS (Transferrin **Saturation**) % = Serum Iron/ TIBC
(Total Iron Binding Capacity)

➤ In the hemodialysis patient with EPO:

1- TFS > 20%

2- SF > 100 NG/ML

Calcium

- ▶ Normal rang: **8.5-10.5** mg/dl
- ▶ Normal for people on Dialysis: 8.5-10.5 mg/dl
- ▶ **Active vitamin D** is needed for absorption.
- ▶ The calcium value multiplied by the phosphorus value should **no exceed 55** or calcium will **deposit** in soft tissues .
- ▶ Calcium can be falsely lower if albumin is low. **Ionized** calcium is a more **accurate** test in this case.



High calcium

- ▶ Check with the doctor if the patient is taking calcium **supplement**
- ▶ **Active vitamin D** these should be temporarily stopped.



Low calcium

- ▶ If albumin levels are low, suggest an ionized calcium be drawn.
- ▶ The patient may need a **calcium supplement** between meals and active **vitamin D** .
- ▶ Check with the physician.

Corrected Calcium

- Each one gram **change** in serum albumin per deciliter changes the serum calcium **concentration by 0.8 mg/dl**. **Normal** serum albumin levels range from about **3.5 to 5.0 g/dl**.
- ❖ In patients with below normal albumin levels, obtaining a corrected calcium value can make the difference between recognizing or missing an accurate diagnosis of real Calcium level.

Calculating Corrected Calcium

Albumin Corrected Calcium =

Serum calcium + [(4 - albumin) X 0.8] = Albumin Corrected Calcium

Example: Ca of 10.5 mg/dl & Alb of 2.5 g/dl:

$$= 10.5 + [(4 - 2.5) \times 0.8] = 11.7 \text{ mg/dl}$$

Laboratory data(cont)

➔ **پره آلبومین:** کمتر از 300 mg/l مستقل از میزان آلبومین قویا پیش بینی کننده افزایش احتمال مرگ و میر است.

➔ **BUN قبل از دیالیز:**

سطح BUN قبل از دیالیز کمتر از 50 mg/dl اغلب ناشی از مصرف ناکافی پروتئین است.

➔ **کراتینین سر:**

افراد با کراتینین کمتر از 10 mg/dl باید از نظر سوء تغذیه بررسی شوند.

Laboratory data(cont2)

► nPCR)nPNA:

بیانگر تعادل نیتروژن بدن بوده و رنج نرمال آن $1/4 - 1/2$ g/kg/day می باشد. اگر کمتر از 1 g/kg/day باشد با افزایش بیماری و احتمال مرگ و میر در ارتباط است.

► کلسترول سرخ:

مارکر با ارزش در بررسی وضعیت تغذیه ای بیماران دیالیزی و پیش بینی کننده افزایش احتمال مرگ و میر می باشد.

کلسترول سرم در $150-180$ mg/dl و یا در حال کاهش باید از نظر احتمال سوء تغذیه بررسی شود.

Phosphorus

- ▶ Normal rang: **2.5-4.8 mg/dl**
- ▶ Normal for people on Dialysis: **3-6 mg/dl**
- ▶ Acceptable levels **depend** on a variety of factors, including: serum calcium, PTH levels, and the level of phosphorus in the diet.

High Phosphorus

- ▶ 800-1000 mg for patient (Limit milk and milk products to 1 serving/day)
- ▶ Remind patient to **take phosphate binders** as ordered with meals and snacks.

Noncompliance with binders is most common cause of high phosphorus levels.



Low Phosphorus

- ▶ Add 1 serving of milk products or other high-phosphorus food per day or decrease phosphate binders.

INTACT PTH

- Normal range: 10-65 PG/ml
- Normal for people on Dialysis: **200-300 PG/ml**
- **A high level of PTH** indicates that calcium is being **pulled out** of bones to maintain serum calcium levels.
- This syndrome is called secondary hyperparathyroidism leads to Kidney osteodystrophy.
- Pulsed doses of oral or IV vitamin D usually lower PTH.

DOQI guideline K/DOQI

Intact PTH (pg/ml)	× P Ca (mg/dl)	Ca (mg/dl)	P (mg/dl)	GFR (ml/min/1.73m ²)	CKD Stage
۳۵-۷۰	۵۵ <	۸/۴-۱۰/۲	۲/۷-۴/۶	۳۰-۵۹	۳
۷۰-۱۱۰		۸/۴-۱۰/۲	۲/۷-۴/۶	۱۵-۲۹	۴
۱۵۰-۳۰۰		۸/۴-۹/۵	۳/۵-۵/۵	یا دیالیزی < ۱۵	۵

High AND LOW PTH TREATMENT

Contact the physician if the patients is taking oral **or IV active v it D**

If the patient **has no symptoms**(high phosphorus, bone pain, fractures)

Treat less **aggressively**.

LOW: NO treatment available



Creatinine

- Normal rang: **0.6-1.5 mg/dl**
- Normal for people on Dialysis: **less than 15 mg/dl**
- Definition : A normal waste product of muscles breakdown

Assessment of creatinine

➤ Dialysis normally controls **cr** levels.

➤ **Low cr** may indicate:

1- good dialysis(kt/v, urea cl)

2- low body muscle(nutrition)



Urea Nitrogen(BUN)

- ▶ Normal rang: **7-23 mg/dl**
- ▶ Normal for people on Dialysis : **50-100 mg/dl**
- ▶ Definition: Waste product of protein breakdown.

High and low BUN

- **High BUN** : under dialysis :
 - 1- check **ekt/v**
 - 2- check **nPNA**
- **Low BUN:**
 - 1- bad nutrition(weakness muscle)

URR and kt/v

- ▶ Normal rang: above **65% or 0.65**
- ▶ No diet changes , but catabolism or anabolism will affect kt/v values.

$K t/v$:

- ▶ Normal rang:
 - 1- Above 1.4 for hemodialysis and **$e kt/v = \text{Above } 1.2$**
 - 2- Above 2 for peritoneal dialysis

Aluminum

- ▶ Normal rang: **0-10 mcg/l**
- ▶ Normal for people on Dialysis: less than **40 mcg/l**
- ▶ Function: patients are taking aluminum $\text{AL}(\text{OH})_3$ phosphate binders may develop **AL toxicity**.

The level of **AL** should be checked every **6 month**.

GOOD LUCK

