# Albumin

**Albumin** (Latin: albus, white) refers generally to any protein with water solubility, which is moderately soluble in concentrated salt solutions, and experiences heat coagulation (protein denaturation). Substances containing albumin, such as egg white, are called *albuminoids*.

## What is albumin?

- Single polypeptide, 585 amino acids.
- MW 66,248; IgG is 150,000
- Highly soluble
- Strong negative charge -17
- Manufactured in the liver @ 9-12g/day
- No storage, no reserve
- Rate of production controlled by changes in colliod osmotic pressure and osmolality of extravascular liver space.
- Production can only increase by a factor of 2 or 3.
- Synthesis is increased by insulin / T4 or cortisol.
- Catabolism is at a rate of 9 - 12 g/day by pinoctosis in cells adjacent to the vascular endothelium.
- Albumin is *not* catabolised in starvation.
- Albumin is an intravascular protein with a concentration of approx 40 g/l.
- Albumin also exists in the extravascular [interstitial] space. In fact the total extravascular albumin exceeds the total intravascular amount by 30%.
- Albumin leaves the circulation via interstitium to lymph system back to the circulation via thoracic duct.
- Circulation time is 16 -18 hours.
- 4 - 5% of total intravascular albumin extravascates per hour: this rate of movement is known as the Transcapillary Escape Rate (TER), and this is determined by:

- Capillary and interstitial free albumin concentration
- Capillary permeability to albumin.
- Movements of solvent / solute.
- Electrical charges across the capillary wall.
- Lymph protein content is 80% that of plasma.

Measurement of serum albumin is by using a dye binding technique using bromocresol green or purple: this tends to overestimate albumin concentration when the serum albumin is low - especially when there is an increased level of a or b globulin. Because of this overestimation, it is rare to see a serum albumin < 10 - 15g/l.

BCP is more sensitive than BCG

**Why is albumin important?**

1. Binding and transport.

2. Maintenance of colloid osmotic pressure.

3. Free radical scavenging.

4. Platelet function inhibition and antithrombotic effects.

5. Effects on vascular permeability.

**Binding and transport**

There are actually four binding sites on albumin and these have varying specificity for different substances. Competitive binding of drugs may occur at the same site or at different sites (conformational changes) [eg. warfarin and diazepam].The drugs that are important for albumin binding are: warfarin, digoxin, NSAIDS, midazolam, thiopentone. The relevance of a low albumin and drug binding is unknown.

**Osmotic pressure**

Albumin is responsible for 75 - 80 % of osmotic pressure.

Starling's equation: Transcapillary Flow = k [(Pcap + pi) - (Pi + p cap)]

Remember that albumin is the main protein both in the plasma and in the interstitium and it is the COP gradient rather than the absolute plasma value that is important: this is what distinguishes hypoalbuminaemia derived from redistribution (capillary leak) from that of pure full body deficiency.

**Free Radicals**

Albumin is a major source of sulphydryl groups; these "thiols" scavenge free radicals (nitrogen and oxygen species).

Albumin may be an important free radical scavenger in sepsis.

**Anticoagulant effects**

The anticoagulant and antithrombotic effects of albumin are poorly understood this may be due to binding nitric oxide radicals inhibiting inactivation and permitting a more prolonged antiaggregatory effect.

In diabetes, glycosylated albumin may increase the incidence of thrombotic events and atherosclerosis.

**Capillary Membrane Permeability**

In sepsis there is an increased rate of albumin loss into the tissues - this is probably related to increased capillary membrane permeability

**What causes serum albumin to decrease?**

Plasma albumin concentration = intravascular albumin mass / plasma volume

Decreased plasma albumin:

1. Decreased synthesis.

2. Increased catabolism [very slow]

3. Increased loss:

    - Nephritic syndrome
    - Exudative loss in burns
    - Haemorrhage
    - Gut loss

4. Redistribution:

    - Haemodilution
    - Increased capillary permeability (Increased interstitial albumin)
    - Decreased lymph clearance

**Consequences of decreased plasma albumin**

1. Decreased ligand binding.

2. Decreased plasma colloid pressure: decreased colloid oncotic pressure, and oedema formation.

The formation of oedema is determined by:

The rate of fluid flux

The clearance of fluid by lymphatics

- In critical illness, there is a stronger correlation between colloid oncotic pressure and Total protein than with albumin.
- In these patients the decreased albumin is compensated for by an increase in acute phase proteins.
- Unquestionably there is increased leakage of albumin and this drags fluid with it.

- Lymphoid function is important - if it is overwhelmed by increased capillary permeability or fluid flux then oedema will occur.
- It is likely that lymphoid dysfunction plays a significant role in oedema formation in critical illness. ?
- Do free radicals cause this lymphoid dysfunction?

Bottom line: low serum albumin does not necessarily mean low plasma oncotic pressure.

**Disease processes associated with Hypoalbuminaemia**

*Malnutrition*

Serum albumin does not appear to decrease in starvation.

The body maintains the serum albumin at the expense of muscular protein:

Decreased synthesis increased redistribution decreased catabolism.

Bottom line: decreased albumin in adults is a marker of associated disease not a feature of isolated protein-energy malnutrition.

*Liver Dysfunction*

Albumin is a poor marker of liver dysfunction; Prothrombin time is more reliable.

*Renal disease*

Albumin loss occurs in nephropathies (nephritic syndrome).

There is a small loss of albumin in dialysis circuits.

*Pre-Eclampsia*

In normal pregnancy there is an increase in plasma volume. In PET there is a paradoxical decrease in plasma volume and capillary leak syndrome.

*Stress response*

Interleukins cause a marked decease in synthesis of plasma proteins other than albumin.

In fact Albumin and Transferrin decrease in the stress response, a process often termed 'negative acute phase proteins'.

IL6 directly decreases the expression of albumin messenger RNA.

Overall, the picture in the stress response is:

1. Initial decrease in albumin associated with increase in acute phase proteins.

2. Subsequent global increase in hepatic protein synthesis; including albumin.

*Burns*

There is massive protein loss from the burn site and increased vascular permeability & decreased albumin synthesis & protein losing nephropathy.

*Trauma*

Increased redistribution and transcapillary escape of albumin.

*Surgery*

Decreased serum albumin preoperatively is an independent indicator of poor outcome

*Sepsis*

SIRS - associated with increased capillary permeability, due to the effects, amongst others, of bacterial endotoxin and cytotoxic T cells.

In sepsis there is a profound reduction in plasma albumin associated with marked fluid shifts.

*Albumin as a prognostic index*

Low albumin is associated with dozens of diseases.

Controversy regarding whether or not albumin is a good indicator of prognosis in critical illness

One recent study suggests:

"In patients with acute and chronic illness serum albumin concentration is inversely related to risk of death. A systematic review of cohort studies meeting specified criteria estimated that for each 2.5 g/l decrement in serum albumin concentration the risk of death increases by between 24% and 56%."

Following serum albumin levels may be of value - initial decrease associated with deterioration, later gradual increase signifies recovery in process.

*Correcting Hypoalbuminaemia*

Low serum albumin concentrations are the consequence of a disease process and successful treatment of the underlying disease should result in a gradual return to normal serum albumin concentrations.

Studies have not shown that the therapeutic 'normalisation' of albumin levels in critically ill patients is beneficial. Indeed the Cochrane group's recent 'meta' analysis suggests a higher mortality rate in critically ill patients treated with albumin.

Previous strategies have involved administering albumin to decrease the loss of intravascular volume by enhancement of colloid oncotic

effect. However, in sepsis, 2/3 of administered albumin has been shown to extravascate within 4 hours of administration.

Debunked Myths (by randomised controlled trials):

- The use of 20% albumin and frusemide to reduce oedema in SIRS.
- The administration of albumin following paracentesis for ascites.
- The use of replacement albumin in nephrotic syndrome.

It is very questionable whether or not albumin should remain the colloid of first choice in pediatric practice.

Commercially available albumin is fractionated in ethanol and purified and heat treated for 10 hours at 60 degrees Celsius.

This process:

Probably alters the charge on albumin - making it more permeable and contains significant quantities of residual ions - aluminum and vanadium**.**

*Recent controversies*

Cochrane Injuries Group Albumin Reviewers

Objective: To quantify effect on mortality of administering human albumin or plasma protein fraction during management of critically ill patients.

Design: Systematic review of randomised controlled trials comparing administration of albumin or plasma protein fraction with no administration or with administration of crystalloid solution in critically ill patients with hypovolaemia, burns, or hypoalbuminaemia.

Subjects: 30 randomised controlled trials including 1419 randomised patients.

Main outcome measure: Mortality from all causes at end of follow up for each trial.

Key messages

- Human albumin solution has been used in the treatment of critically ill patients for over 50 years
- Currently, the licensed indications for use of albumin are emergency treatment of shock, acute management of burns, and clinical situations associated with hypoproteinaemia
- Our systematic review of randomised controlled trials showed that, for each of these patient categories, the risk of death in the albumin treated group was higher than in the comparison group
- The pooled relative risk of death with albumin was 1.68 (95% confidence interval 1.26 to 2.23) and the pooled difference in the risk of death was 6% (3% to 9%) or six additional deaths for every 100 patients treated
- We consider that use of human albumin solution in critically ill patients should be urgently reviewed

*Counter point*

Neil Soni, *Consultant in intensive care.*
I was asked to review the Cochrane Injuries Group's paper for the *BMJ*. I quote from my covering letter: "It should not be published."

- Altogether 30 randomised studies with population sizes ranging from 12 to 219 (over half had fewer than 30 patients) were assessed, with a total of 1419 patients. No account taken of the purpose, design, or specific end points of the studies.
- The end point of the review mortality was not an end point in most studies, many of which were over less than five days.
- Most deaths occurred outside the study times.
- Variables ignored included age, medical conditions, severity of disease, dose of albumin, mode of administration, and attributable mortality of the states of disease that were treated.

- The evolution of fluid management between the 1970s and now was also dismissed. Common factors were randomised controlled trials that compared administration of albumin with no administration or administration of crystalloid, and, of course, the term 'critically ill.'
- The message, presented with the combined weight of Cochrane and the *BMJ*, is that albumin, whether used in neonates or adults, whether for volume replacement or the support of biochemical variables, whether given intraoperatively as a single dose or long term over days or weeks, is potentially hazardous.
- Practice is already changing. Change, with its potential hazards, is entirely justifiable if the evidence is powerful enough to decree change but it is not.
- The review is a tribute to an association of key words and modern computer technology, and the results are serendipitous and amount to evidence that is at best circumstantial.
- The author talks of totality of available evidence, but is that totality synonymous with adequacy?
- Evidence should lead to change, but surely there is a responsibility to ensure that the weight of evidence published by august bodies is adequate to justify that change.
- Does the responsibility lie with the researcher, the reviewer, or the journal? When does a strongly negative peer review become negative? Surely negative reviews should be acknowledged by the journal, otherwise publication fraudulently implies positive peer review.
- Finally, are these review methods valid? It is time to define their value because I believe that otherwise such studies will damage the credibility of not only the methods used, which are potentially powerful and useful, but also of the journals that carry them.

*Authors Response:*

On the basis of our systematic review of randomised trials we concluded that "there is no evidence that albumin administration

reduces mortality in critically ill patients and a strong suggestion that it may increase mortality. We read with anticipation the letters in response to our review, but note with concern that none of the correspondents provide any evidence that albumin is beneficial in critically ill patients, in which case our conclusions stand.

*What is albumin?*

Albumin is an important intravascular and extravascular protein; it contributes strongly to the maintenance of colloid osmotic pressure.

*Why is it important?*

Binding and transport, osmotic pressure, free radical scavenging, platelet function inhibition and antithrombotic effects

*What causes serum albumin to decrease?*

Decreased synthesis, increased catabolism, increased loss & redistribution

- *Consequences of decreased plasma albumin*

1. Decreased ligand binding.

2. Decreased plasma colliod pressure

- *Disease processes associated with Hypoalbuminaemia*

In critical illness, there is a stronger correlation between colloid oncotic pressure and Total protein than with albumin.

Albumin decreases in burns, liver disease, renal disease, pre-Eclampsia, stress and sepsis.

- *Albumin as a prognostic index*

Serum albumin concentration in critical illness is inversely related to the risk of death.

- *Correcting Hypoalbuminaemia*

The "normalisation" of plasma albumin concentrations has nor been shown to improve outcome in critical illness and in many of the traditional therapeutic roles of albumin

- *The recent fuss about albumin*

The Cochrane report in the BMJ in July 1998 suggested that treatment with albumin was related to a 6% excess of deaths above control. Although this study was flawed in many ways, it has illustrated what many have believed for some time: that therapeutic albumin therapy has little role in the management of most patients. Nevertheless, where albumin's use is well defined - in pediatrics / burns, its abandonment does not appear justified at this time.

Serum albumin

The most well-known type of albumin is the serum albumin in the blood. Serum albumin is the most abundant blood plasma protein and is produced in the liver and forms a large proportion of all plasma protein. The human version is human serum albumin, and it normally constitutes about 60% of human plasma protein; all other proteins present in blood plasma are referred to collectively as globulins.

Serum albumins are important in regulating blood volume by maintaining the osmotic pressure of the blood compartment. They also serve as carriers for molecules of low water solubility, including lipid soluble hormones, bile salts, bilirubin, free fatty acids (apoprotein), calcium, iron (transferrin), and some drugs. Competition for albumin binding sites between drugs may cause drug interaction by increasing the free fraction so that enhanced potency.

Specific types include:

- human serum albumin

- bovine serum albumin (cattle serum albumin) or BSA, often used in medical and molecular biology labs.

Low albumin (hypoalbuminaemia) may be caused by liver disease, nephrotic syndrome, burns, protein-losing enteropathy, malabsorption, malnutrition, late pregnancy, artefact, posture, genetic variations and malignancy.

High albumin is either caused by dehydration or artefact (A product of artificial character due to extraneous agency. A product or formation in a microscopic part of a fixed tissue or cell that is caused by manuplation or reagents, which is not indicative of the actual structural relationship. Artefacts also mean an ECG or EKG wave that arises other than heart or brain.

Normal range of human serum albumin in adults (> 3 y.o.) is 3.5 to 5 g/dL. For children less than three years of age, the normal range is broader, 2.5-5.5 g/dL.

*Other types*

Albumins are an important class of protein, and they are vitally important to health and well being for many organisms. Many plants and animals contain or secrete albumin. A protein classified as albumin is globular, meaning that it is soluble in water. Globular proteins also have a roughly spherical structure. When combined with water, albumin and other globular proteins form a colloid, a solution which appears homogeneous although it actually contains multiple substances. The other type of protein, fibrous protein, such as that found in muscles, is not water soluble, and it has a different basic structure.

Within the human body, albumin is an important component of life. Albumin in the human body transports essential fatty acids from adipose tissue, otherwise known as fat, to muscle tissue. It also contributes to the regulation of osmosis, helping to transport

hormones, drugs, and other substances through the blood. An albumin deficiency can lead to medical issues.

Other types include the storage protein ovalbumin in egg white, and different storage albumins in the seeds of some plants. Note that albumin is spelled with an "i" while "albumen" with an "e" is the white of an egg, the part of the egg from which meringues are made. When heated, albumin tends to coagulate. This property proves very useful in cooking, and is one of the reasons why eggs are so frequently used in baking. The albumin in the egg whites helps baked goods hold their structure. The albumin in egg whites is also used for purification, as it tends to trap and store impurities. Egg whites are used to refine dishes like soup, and to treat people with certain types of poisoning, since the albumin binds to the toxin. Technically, the albumin found in egg whites is more formally known as ovalbumin. When it is cooked, the proteins begin to unfold, recombining in a new configuration. As it is cooked, the albumin in egg whites also turns white and opaque. When beaten, the ovalbumin unfolds partially, creating filmy foam which encloses pockets of air. As anyone who has beaten eggs too much is aware, when the proteins are beaten too much, they unfold completely and lose structure. Since albumin is flexible, it expands with the air trapped inside the pockets as it bakes, and it will retain the larger shape and yield a light, fluffy texture.

*Albumin dialysis in cirrhosis with superimposed acute liver injury.*

Patients with liver cirrhosis and a superimposed acute injury with progressive hyperbilirubinemia have a high mortality. A prospective, controlled study was performed to test whether hyperbilirubinemia, 30-day survival, and encephalopathy would be improved by extracorporeal albumin dialysis (ECAD).
Twenty-four patients were studied; 23 patients had cirrhosis; 1 had a prolonged cholestatic drug reaction and was excluded from per protocol (PP) analysis. Patients had a plasma bilirubin greater than 20 mg/dL and had not responded to prior standard medical therapy

(SMT). Patients were randomized to receive SMT with ECAD or without (control). ECAD was performed with an extracorporeal device that dialyzes blood in a hollow fiber dialyzer (MW cutoff < 60 kd) against 15% albumin. Albumin-bound molecules transfer to dialysate albumin that is regenerated continuously by passage through a charcoal and anion exchange column and a conventional dialyzer. ECAD was associated with improved 30-day survival (PP, 11 of 12 ECAD, 6 of 11 controls; log rank P <.05). Plasma bile acids and bilirubin decreased on average by 43% and 29%, respectively, in the ECAD group after 1 week of treatment, but not in the control group. Renal dysfunction and hepatic encephalopathy improved in the ECAD group, but worsened significantly in the control group. ECAD was safe, with adverse events being rare and identical in both groups. In conclusion, ECAD appears to be effective and safe for the short-term treatment of patients with cirrhosis and superimposed acute injury associated with progressive hyperbilirubinemia and may be useful for increasing survival in such patients awaiting liver transplantation.

*Test in Urine*

Protein is not normally found in large quantities in the urine. However, the presence of protein in the urine can indicate a multitude of disorders.

Urine protein is roughly divided into urine albumin and globulins. Urine protein electrophoresis may be recommended to help determine the cause of protein in the urine, or as a screening test to measure the various proteins in urine.

## Normal Results

No significant amount of globulins in the urine.

Urine albumin is less than 50 mg/dL.

*What Abnormal Results Mean*

- Acute inflammation
- Amyloidosis
- Decreased kidney function
- Diabetic nephropathy
- Kidney failure
- Multiple myeloma
- Nephrotic syndrome
- Acute urinary tract infection

*Considerations*

Drugs that can affect the measurement of proteins include chlorpromazine, corticosteroids, isoniazid, neomycin, phenacemide, salicylates, sulfonamides, and tolbutamide. Never stop taking any medication without consulting your health care provider.

Albumin is the most abundant serum protein. It has a molecular weight of 65,000 and consists of 584 amino acids and contains no carbohydrate. Albumin is produced exclusively in the liver and secreted directly into the circulation. Physiological roles includes maintenance of oncotic pressure (albumin provides 80% of the plasma oncotic pressure), and transport of small molecules such as calcium, unconjugated bilirubin, free fatty acids, cortisol and thyroxine. Albumin also binds drugs in the serum, eg warfarin, phenylbutazone and clofibrate.

The half-life of albumin in the circulation is about 20 days and the liver has large reserves of albumin synthetic capacity. Although albumin is the most abundant serum protein, it contributes little to the osmolality as the concentration is about 0.6 mmol/L when expressed in SI units.

Serum albumin is a useful marker of chronic liver disease and nutritional status, although consideration must be given to other factors contributing to the level.

*High albumin concentrations in plasma*

Elevated concentrations of albumin in plasma are caused by a relative loss of water. This occurs in dehydration, or with prolonged use of a tourniquet. There are no pathological conditions other than dehydration associated with a high albumin concentration. Note however that elevated albumin may indicate artefactual elevation of other analytes such as haemoglobin, lipids and calcium.

*Low albumin concentrations in plasma*

*Causes*

Low concentrations of serum albumin may be caused by artefact, decreased albumin production, increased loss, or redistribution in the body.

- Artefact: usually due to drip-arm contamination of the sample.
- Decreased production: malnutrition, malabsorption, chronic liver disease (eg cirrhosis) or the acute phase response.
- Increased loss: protein-losing states (nephrotic syndrome, protein-losing enteropathy), severe burns, during operative procedures.
- Redistribution: during sepsis albumin may be lost into the extravascular compartment due to increased vascular permeability, in ascites due to an exudate albumin is lost into the abdominal cavity.

Note that low serum albumin does not occur in uncomplicated acute viral hepatitis, and a normal serum albumin makes the diagnosis of cirrhosis unlikely.

*Effects of low plasma albumin*

The effects of low plasma albumin are mainly related to maintenance of fluid in the circulating compartment. With reduced levels of serum albumin fluid may escape into tissues to cause oedema or into body

cavities to cause ascites or pleural effusions. Extremely low albumin may also affect the delivery of nutrients to tissues by the formation of localised tissue oedema. Reduced or increased levels of albumin in a sample will affect the measurement of total serum calcium, with low albumin producing a low serum total calcium (and vice versa) These conditions do not indicate a disorder of calcium metabolism.

*Indications for Measurement*

Albumin should be measured whenever liver disease is suspected, in cases of oedema, if malnutrition or malabsorption is suspected, or if a protein-losing state (nephrotic syndrome, protein-losing enteropathy or burns) is suspected. Albumin can be a useful monitor of these conditions but repeat measurements at intervals of less than 1 week are rarely indicated and longer intervals are appropriate in non-acute cases.

Albumin should also be measured whenever total serum calcium is requested.

*Albumin Measurement*

Plasma albumin is a component of the Liver Function Tests (LFTs) but may be ordered separately.

*Albumin*

*Human serum albumin* is the most abundant protein in human blood plasma. Albumin is a protein made by the liver. Albumin comprises about half of the blood serum protein. It is soluble and monomeric.

Albumin transports many small molecules in the blood (for example, bilirubin, calcium, progesterone, and drugs). It is also of prime importance keeping the fluid from the blood from leaking out into the tissues. This is because, unlike small molecules such as sodium and chloride, the concentration of albumin in the blood is much greater than it is in the fluid outside of it.

The gene for albumin is located on chromosome 4 and mutations in this gene can result in various anomalous proteins. The human albumin gene is 16,961 nucleotides long from the putative 'cap' site to the first poly (A) addition site. It is split into 15 exons which are symmetrically placed within the 3 domains that are thought to have arisen by triplication of a single primordial domain.

Albumin is synthesized in the liver as preproalbumin which has an N-terminal peptide that is removed before the nascent protein is released from the rough endoplasmic reticulum. The product, proalbumin, is in turn cleaved in the Golgi vesicles to produce the secreted albumin.

The reference range for albumin concentrations in blood is 30 to 50 g/L. It has a serum half-life of approximately 20 days. It has a molecular mass of 67 kDa.

*Functions of albumin*

- Maintains oncotic pressure
- Transports thyroid hormones
- Transports other hormones, particularly ones that are fat soluble
- Transports fatty acids ('free' fatty acids) to the liver
- Transports unconjugated bilirubin
- Transports many drugs; serum albumin levels can affect the half-life of drugs
- Competitively binds calcium ions ($Ca^{2+}$)
- Buffers pH
- Serum albumin, as a negative acute-phase protein, is down-regulated in inflammatory states. As such, it is not a valid marker of nutritional status; rather, it is a marker in inflammatory states

*Pathology*

*Hypoalbuminemia*

Low blood albumin levels (hypoalbuminemia) can be caused by:

- Liver disease; cirrhosis of the liver is most common
- Excess excretion by the kidneys (as in nephrotic syndrome)
- Excess loss in bowel (protein losing enteropathy e.g. Menetrier's)
- Burns (plasma loss in the absence of skin barrier)
- Redistribution (hemodilution [as in pregnancy],
- Increased vascular permeability or decreased lymphatic clearance)
- Acute disease states (referred to as a negative acute phase protein)
- Mutation causing analbuminemia (very rare)

*Hyperalbuminemia*

Typically this condition is a sign of severe or chronic dehydration. Chronic dehydration needs to be treated with zinc as well as with water. Zinc reduces cell swelling caused by increased intake of water (hypotonicity) and also increases retention of salt. In the dehydrated state the body has too high of an osmolarity and apparently discards zinc to prevent this. Zinc also regulates transport of the cellular osmolyte taurine and albumin is known to increase cellular taurine absorption. Zinc has been shown to increase retinol (vitamin A) production from beta-carotene, and in lab experiments retinol reduced human albumin production. It is possible that a retinol (vitamin A) deficiency alone could cause albumin levels to become raised. Patients recovering from chronic dehydration may develop dry eyes as the body uses up its vitamin A store. Interestingly, retinol causes cells to swell with water (this is likely one reason that too much vitamin A is toxic).

*Glycation (Glycosylation)*

It has been known for a long time that human blood proteins like hemoglobin and serum albumin may undergo a slow non-enzymatic glycation, mainly by formation of a Schiff base between ε-amino

groups of lysine (and sometimes arginine) residues and glucose molecules in blood (Maillard reaction). This reaction can be inhibited in the presence of antioxidant agents. Although this reaction may happen normally, elevated glycoalbumin is observed in diabetes mellitus.

Glycation has the potential to alter the biological structure and function of the serum albumin protein. Moreover, the glycation finally can result in the formation of Advanced Glycosylation End Products (AGE), which results in abnormal biological effects. Accumulation of AGEs leads to tissue damage via alteration of the structures and functions of tissue proteins, stimulation of cellular responses, through receptors specific for AGE-proteins, and via generation of reactive oxygen intermediates. AGEs also react with DNA, thus causing mutations and DNA transposition. Thermal processing of proteins and carbohydrates brings major changes in allergenicity. AGEs are antigenic and represent many of the important neoantigens found in cooked or stored foods. They also interfere with the normal product of nitric oxide in cells.

Although there are several lysine and arginine residues in the serum albumin structure, very few of them can take part in the glycation reaction. It is not clear exactly why only these residues are glycated in serum albumin.

*Testing for albumin loss via the kidneys*

In the healthy kidney, albumin's size and negative electric charge exclude it from excretion in the glomerulus. This is not always the case, as in some diseases including diabetic nephropathy, a major complication of uncontrolled diabetes where proteins can cross the glomerulus. The lost albumin can be detected by a simple urine test. Depending on the amount of albumin lost, a patient may have normal renal function, microalbuminuria, or albuminuria.

*Serum Albumin—Testing*

A serum albumin test measures the amount of this protein in the clear liquid portion of the blood. A blood sample is needed.

Drugs that can increase albumin measurements include anabolic steroids, androgens, growth hormone, and insulin; stop taking these drugs for atleast a week before the test. If you are receiving large amounts of intravenous fluids, the results of this test may be inaccurate. Albumin will be decreased during pregnancy.

This test can help determine if a patient has liver disease or kidney disease, or if the body is not absorbing enough protein.

Albumin helps move many small molecules through the blood, including bilirubin, calcium, progesterone, and medications. It plays an important role in keeping the fluid from the blood from leaking out into the tissues.

Because albumin is made by the liver, decreased serum albumin may be a sign of liver disease. It can also result from kidney disease, which allows albumin to escape into the urine. Decreased albumin may also be explained by malnutrition or a low protein diet.

*Normal Results*

The normal range is 3.4 - 5.4 grams per deciliter (g/dL).

*What Abnormal Results Mean*

Lower-than-normal levels of albumin may indicate:

- Ascites
- Burns (extensive)
- Glomerulonephritis
- Liver disease (for example, hepatitis, cirrhosis, or hepatocellular necrosis)
- Malabsorption syndromes (for example, Crohn's disease, sprue, or Whipple's disease)
- Malnutrition

- Nephrotic syndrome

Additional conditions under which the test may be performed:

- Diabetic nephropathy/sclerosis
- Hepatic encephalopathy
- Hepatorenal syndrome
- Membranous nephropathy
- Tropical sprue
- Wilson's disease

This test helps in determining if a patient has liver disease or kidney disease, or if not enough protein is being absorbed by the body.

Because albumin is made by the liver, decreased serum albumin may result from liver disease. It can also result from kidney disease, which allows albumin to escape into the urine. Decreased albumin may also be explained by malnutrition or a low protein diet.

Albumin is synthesized by the liver using dietary protein. Its presence in the plasma creates an osmotic force that maintains fluid volume within the vascular space. A very strong predictor of health; low albumin is a sign of poor health and a predictor of a bad outcome.