

ROUTINE LAB STUDIES

Routine Clinic Lab Studies

With all lab studies, a tacrolimus or other drug level will be obtained. These drug levels are routinely assessed to ensure that there is enough or not too much anti-rejection medicine within the blood stream. Here are the general guidelines for all blood draws:

- The tacrolimus or other drug level is assessed at its lowest level just before the next dose of medicine. This is called a “trough level.” This means that you need to have the lab studies drawn within 12 hours after the last dosage of medicines. An example of this is if you gave your child tacrolimus at 8:00 p.m. the night before clinic, you need to have your child’s labs drawn by 8:00 a.m. the next day.
- **DO NOT** give your child either the tacrolimus or other main immunosuppression drug (cyclosporine or everolimus) **before** the blood draw. Once the blood has been drawn, then give your child his/her medicine. This means you must bring it with you.
- For all lab studies that will be drawn at Michigan Medicine on a clinic appointment day, the lab orders have already been ordered in the system. The labs will be sent right away. Many times, the transplant team may have the lab results available for you before leaving clinic that day. However, the tacrolimus or other drug level will not be ready for review until later that day.
- For all routine local lab studies, the transplant coordinator will provide you a lab requisition or lab slip for you to take to the local lab. The lab slip will be good for six months and will be updated with each clinic visit. The transplant coordinator will also inform you about the needed frequency of the routine lab studies. It is important to mark the date needed for the lab studies on your calendar for review.
- The local lab will draw and fax the results to the transplant center for review. Some local lab centers are not able to process either the tacrolimus or other drug level. In that case, the transplant nurse coordinator might provide you some mailing boxes to have **ONLY** one purple tube of blood to be sent to the University of Michigan for processing. There will be no cost to you for mailing the blood specimen to the hospital. You **MUST** make sure that the tube of blood has your child’s full name, date of blood draw, date of birth and University of Michigan hospital ID number. Without the proper identification, the blood specimen will not be processed.
- Once your child has had the local lab studies drawn, please notify the transplant office. There are some lab centers that will need to be called for the results.
- The transplant nurse coordinator will contact you once a physician has reviewed your child’s lab results.



Laboratory Result Sheet – Explanation of the Tests and Abbreviations

1	2	3	4	5	6	7	8	9	10	11	12
CsA ng/mL	Tacro ng/mL	EVER ng/mL	Siro ng/mL	Na+ MEQ/L	K+ MEQ/L	Cl- MEQ/L	CO2 MEQ/L	BUN MG/DL	Creat MG/DL	Gluc GM/DL	Prot GM/DL

13	14	15	16	17	18	19	20	21	22	23	24
Alb GM/DL	Ca++ MG/DL	PO4 MG/DL	Mg+ MEQ/L	AFP ng/mL	Dbil MG/DL	lbil MG/DL	TBili MG/DL	ALK0 IU/L	AST IU/L	ALT IU/L	Chol MG/DL

25	26	27	28	29	30	31	32	33	34	35
Trig MG/DL	HDL MG/DL	LDLC MG/DL	URIC MG/DL	PT SEC	INR	PTT SEC	WBC K/MM3	Hgb GM/DL	Hct %	Plat K/MM3

Medicines

1. CsA - cyclosporine (Neoral; Gengraf)

This is a medicine used to prevent rejection. It is in a group of medicines called calcineurin inhibitors. It is also called an immunosuppressant, which means it helps control your immune system. The levels are measured in blood samples in units called nanograms (ng) per milliliter (mL), abbreviated ng/mL. We check this level to make sure you are taking the right dose of medicine to help avoid either side effects or rejection, and your goal level depends on many things including how far away from transplant you are and any complications such as rejection you have had. Different patients may need very different doses in order to maintain the same level. You are usually taking either this medicine or tacrolimus.

2. Tacro - tacrolimus (Prograf)

This is the main medicine used to prevent rejection in most pediatric liver transplant clinics. Like cyclosporine, it is a calcineurin inhibitor and an immunosuppressant. The levels are also measured in blood samples in units called nanograms (ng) per milliliter (mL), abbreviated ng/mL. We check this level to make sure you are taking the right dose of medicine to help avoid either side effects or rejection, and your goal level depends on many things including how far away from transplant you are and any complications such as rejection you have had. Different patients may need very different doses in order to maintain the same level. While there are reasons some patients may need to be on cyclosporine, most will take tacrolimus as their main anti-rejection medicine.

3. EVER - everolimus (Zortress; Affinitor)

This is another medicine used to prevent rejection, and it can be used either along with or instead of cyclosporine or tacrolimus. It is in a group of medicines called mTOR inhibitors that are different from calcineurin inhibitors, but it is also an immunosuppressant meaning it helps control your immune system. The levels are also measured in blood samples in units called nanograms (ng) per milliliter (mL), abbreviated ng/mL. We check this level to make sure you are taking the right dose of medicine to help avoid either side effects or rejection, and your goal level depends on many things including how far away from transplant you are and any complications such as rejection you have had. Different patients may need very different doses in order to maintain the same level. Everolimus is not used very frequently, so you may never have to take this medicine.

4. Siro - sirolimus (Rapamune)

This is another medicine used to prevent rejection. Like everolimus, it is an mTOR inhibitor and an immunosuppressant. The levels are also measured in blood samples in units called nanograms (ng) per milliliter (mL), abbreviated ng/mL. We check this level to make sure you are taking the right dose of medicine to help avoid either side effects or rejection, and your goal level depends on many things including how far away from transplant you are and any complications such as rejection you have had. Different patients may need very different doses in order to maintain the same level. Most individuals do not use this medicine so it is likely you will never use it.

Electrolytes and Other Chemicals in the Blood

5. Na⁺ - sodium

This is one of the important salts in your body that is necessary for proper growth and normal function of your body's cells. This test can be abnormal if your liver is not working well, you are dehydrated, or if you have problems with drugs or other glands in your body. This will be normal in most people after transplant.

6. K⁺ - potassium

This is a salt that is important for many parts of your body to work well. Calcineurin inhibitors (CsA and Tacro - see above) can change how your kidneys handle potassium and lead to it being too high (above the normal range). This is more common early after transplantation or after an episode of rejection when you are on higher doses of these medicines. It only occasionally is high enough to need treatment.

7. Cl - chloride

This chemical helps keep your cells and your blood balanced and can change if you are having lots of vomiting or diarrhea. It is most directly associated with the level of your CO₂ (bicarbonate), the next test on the list. This level can also be affected by calcineurin inhibitors because of their effect on kidney function.

8. CO₂ - carbon dioxide (bicarbonate)

This is a reflection of how much acid you have in your body and bloodstream. If you have a lot of diarrhea, this can be very low. If you have a lot of vomiting, then it can be high. When you are on calcineurin inhibitors, they can change how your kidneys work and lead to your body having too much acid in it which we call a renal (kidney) tubular (part of the kidney that helps make urine) acidosis (too much acid) type 4 (caused by medicine).

Kidney Screening Tests

9. BUN - blood urea nitrogen

This is used as a test of kidney function. It can be very high when you are dehydrated or when you have problems with your kidneys. When you are taking CsA or Tacro (see above), you can be very sensitive to even mild dehydration (for example, not drinking enough in the summer when you are outside more, sweating more, etc). Since NSAIDs such as ibuprofen can also cause kidney damage, we do not recommend taking this medication if you are on a calcineurin inhibitor. If BUN is above 20 MG/DL, you will often receive a call from the office asking you to increase your water intake. BUN is also related to your protein intake and metabolism, so in some patients it can be high if you are eating a lot of protein even if your kidneys are working fine.

10. Creat - creatinine

This test helps us monitor how your kidneys are working. It can be affected by a number of factors, but if it is higher than would be expected based on your size and age, it raises concern that your kidneys may not be working as well as they should. If it is high, you may need more testing to decide if you need a different treatment or a change in medicine. Creatinine can also be affected by certain medicines including NSAIDs, as well as some medicines patients who have had a transplant take.

General Health Tests

11. Gluc - glucose

This test shows the amount of sugar in your blood. Some individuals can develop diabetes after a transplant or after an episode of rejection. This is especially true if other members of your family have problems with diabetes or you are very overweight. Glucose level can also be affected by when you last ate something (not fasting), by being overweight, or by medicines (like prednisone).

12. Prot - total protein

This test measures the combination of albumin and immunoglobulins (antibodies) in your blood. In some individuals with illnesses like autoimmune hepatitis or hepatitis C, this level can be very high because of the high level of immunoglobulins.

13. Alb - albumin

This is one of the main proteins made by the liver that circulates in the blood. Once the liver makes it, it stays in the blood for weeks. This can help us know that you are well nourished and that the liver has been working well over the last several weeks.

Bone Tests

14. Ca⁺⁺ - calcium

This mineral is important for muscles to work correctly and for your bones to grow normally. Its level can be affected by having too little in your diet, by losses in your stool or from the kidney, or by vitamin D deficiency. Mild vitamin D deficiency is common, especially in the winter in Michigan when there is very little exposure to sunlight.

15. P₀₄ - phosphorus

This mineral is also important for normal bone formation. It will be balanced with calcium under most circumstances. This level can be abnormal if your kidneys are sick or if you have vitamin D deficiency, parathyroid problems, or bone problems.

Side Effects of Medicine (Calcineurin Inhibitors)

16. Mg⁺ - magnesium

This metal is important for many processes in the body including muscle function. If your magnesium is low, your calcium can also be low. In individuals taking calcineurin inhibitors (CsA or Tacro), magnesium can be low because of losses from the kidney. You can also lose magnesium in your stool if you have severe diarrhea. Many individuals require supplements after transplant.

Not Routinely Measured

17. AFP - alpha-fetoprotein

AFP is a protein that may be elevated in several situations, including when there is a tumor in the liver. If you were transplanted for a liver tumor or we are watching to make sure you do not develop one, then we will check AFP regularly. However some patients may never have this lab checked.

Liver or Bile Duct Problem Screening Tests

18. Dbil - direct bilirubin (in some labs called conjugated bilirubin)

If this is high, it raises concern about liver disease or bile duct problems. Some medicines can also cause increases in this type of bilirubin. We will sometimes follow the total bilirubin (see below) as the first indicator of a possible problem and only check a direct bilirubin if the total is high.

19. Ibil - indirect bilirubin (in some labs called unconjugated bilirubin)

This type of bilirubin results from the breakdown of hemoglobin (carries oxygen in your red blood cells) when the red blood cells die. It can be high if you have increased breakdown of your red blood cells, or if you convert indirect bilirubin to the direct form more slowly than in most people due to a certain enzyme problem. This is called Gilbert's syndrome which is not a disease and only is a problem with certain rare drugs like irinotecan which is used to treat some cancers.

20. TBili - total bilirubin

This is the total of both direct and indirect bilirubin. Total bilirubin is used as part of calculating your PELD or MELD score, if you are listed for a liver transplant.

21. Alk0 - alkaline phosphatase

This is an enzyme that is present in bile ducts, intestine, and bone. We use it as a screening test for possible problems in the bile ducts after liver transplantation, but it is more commonly elevated because of growth (comes from bone) in young children or adolescents. It can also be high from intestinal injury associated with diarrhea in younger children. If we are concerned about possible bile duct problems, we will often measure another test called GGT (or gamma-glutamyl transpeptidase) which is more specific for bile ducts in younger children.

Liver Enzymes

22. AST - aspartate aminotransferase

AST is called a liver enzyme, but it exists in greater amounts in muscle and red blood cells. It can be elevated in circumstances where no liver disease is present or because of viral infections, which do not reflect long-term problems with the liver. However, this test is used to screen for the possibility of liver injury or rejection.

23. ALT - alanine aminotransferase

ALT is the other liver enzyme; it is also present in muscle and red blood cells but to a lesser degree than AST. This enzyme is called liver specific as there is more of this enzyme present in the liver than AST. The most common reason for it to be elevated is a viral infection. It is used as a test to screen for the possibility of liver injury or rejection. See AST description above for additional information.

Heart Disease Risk Screening

24. Chol - cholesterol

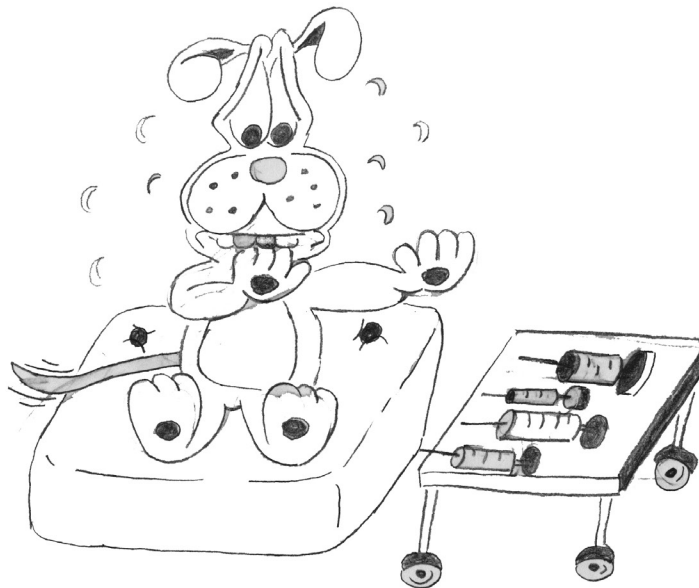
This test can be increased by some medicines, being overweight, and by family history (tendency you inherit from your parents). Because liver transplant works so well, we monitor this to make sure we recognize any risks you might have for heart disease so that we can suggest changes in lifestyle (like more exercise and change in diet) and/or medications if necessary. Cholesterol can also be elevated in some patients with certain diseases before a liver transplant.

25. Trig - triglycerides

This fat-related molecule can be high with diabetes, in certain families, and also on certain medications. Consistently high fasting levels can increase the risk for heart disease.

26. HDL - This is a type of cholesterol

It is the “good” cholesterol in the body.



By Brandon Cof

27. LDLC - LDL calculated

LDL is the “bad” type of cholesterol in the body that can increase risk for heart disease and other health problems.

28. URIC - uric acid

This is not a routine lab after liver transplantation, but it is sometimes useful for helping determine kidney function, dehydration, or certain types of diseases.

Liver Synthetic Function (Does it Make the Right Proteins)

29. PT - prothrombin time

PT is a measure of how well your blood clots. If you do not have a normal amount of vitamin K in your body, this test can be abnormal (the most common reason for it to be high actually). If the liver stopped making these clotting proteins, PT would become abnormal within a few hours as you need a constant supply of clotting proteins from the liver.

30. INR - international normalized ratio

INR is a ratio that allows us to compare a PT test done anywhere in the world to those done in our laboratory so that we know if your test is normal or abnormal.

31. PTT - partial thromboplastin time

PTT is another clotting test. It is usually not important for monitoring your liver function.

Complete Blood Count

32. WBC - white blood cell count

These are the cells in your body that fight off infections. Steroids (like prednisone) can make this count rise, and medicines like Cellcept and Valcyte can make this count lower than normal. The count can also be low if your spleen is overactive like when you have severe liver disease with portal hypertension and a large spleen. These are also the cells responsible for rejection.

33. Hgb - hemoglobin

This is a measure of whether or not you have iron-deficiency or anemia; this molecule carries oxygen in the red blood cells to your tissues.

34. Hct - hematocrit

This is the percent of your blood that is made up of red blood cells. If it is too low, then you have anemia. The most common reason is because of iron deficiency.

35. Plat - platelets

These pieces of cells (come from megakaryocytes) are important for clotting. They can be low because of some medications or an overactive spleen.