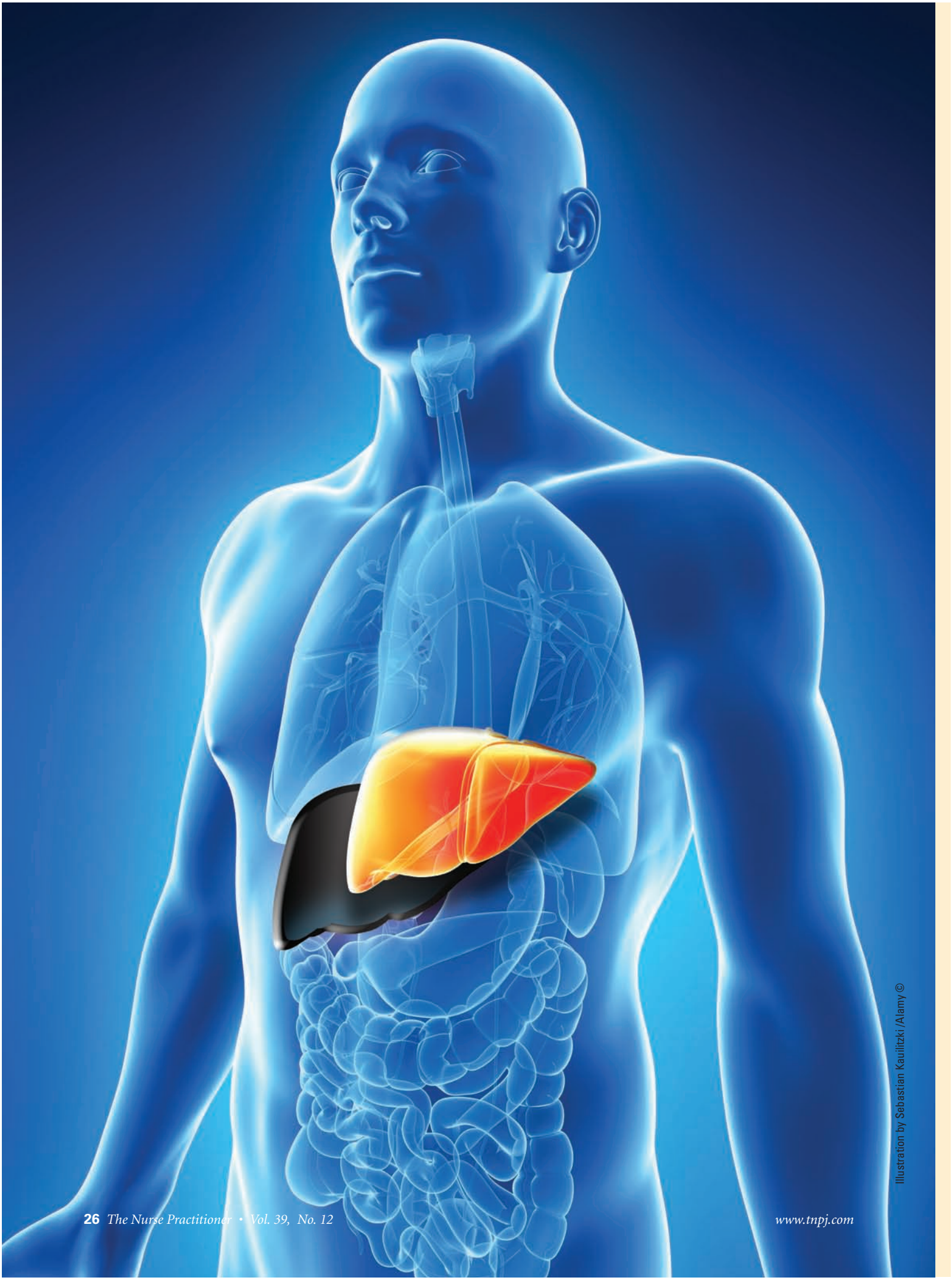

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Primary care management of the liver transplant patient

Abstract: There are over 65,000 people in the United States who have received a liver transplant. In primary care practice, nurse practitioners must be aware of the special considerations necessary for this population.

By Amanda Chaney, MSN, ARNP, FNP-BC

Over 65,000 people in the United States have received a liver transplant (LT).[1] In most transplant programs, transplant hepatologists and surgeons monitor the patient closely during the first few months post-LT. The primary care nurse practitioner (NP) may have concerns or be apprehensive about caring for LT patients when these patients arrive in their office for primary care. The purpose of this article is to provide guidelines and direction for the NP in providing primary care to LT patients.

Patients needing an LT have surgery for many reasons (see *Common reasons for LT*). Hepatitis C-related cirrhosis followed by alcoholic liver disease are the most common causes for LT.[1] There are several ways to perform a liver transplant, and there are complications related to each type of surgery (see *Liver transplantation: duct-to-duct anastomosis*; *Liver transplantation: Roux-en_Y anastomosis*, and *Liver transplantation: living donor*.) NPs should be familiar with these basic surgical techniques and which type of procedure his or her patient has had.

LT patients are at risk for several complications. The primary care NP should be aware of these complications and needs to know when referral back to a transplant center or hepatologist is appropriate. The most serious issues are problems with the vasculature of the liver, biliary issues, rejection, and infection. Lab abnormalities—specifically elevation in alkaline phosphatase, alanine aminotransferase (ALT), and serum bilirubin levels—are usually the first indication of a problem in one or more of these areas.

Liver-related complications

For liver-related complications, including issues with the liver vasculature, biliary system, and issues with rejection, prompt consultation with a transplant center and transplant hepatologist is recommended for patient evaluation and treatment (see *Recommended studies for LT patients based on abnormalities*).

Infection. Eighty percent of patients will have at least one infection in the first postoperative year after transplant.[2] Infections are the primary cause of critical illness and death following LT.[3] Many of these patients have a certain degree of debility and malnutrition pretransplant, which places them at higher risk for infection.[2,4] Simple health promotion activities can minimize infection risk, including frequent hand washing, avoidance of highly-populated public places and/or wearing a mask in such situations, and consuming filtered water rather than water from rivers or lakes. High-risk pets, such as birds, rodents, snakes, and chickens,

Keywords: liver-related complications, liver transplant, nurse practitioners, primary care management

can carry infections that can be detrimental to the posttransplant patient, and therefore, should be avoided. Specific food considerations are recommended as well, including avoidance of unpasteurized products (eggs and milk) and undercooked meats and eggs. Hiking and outdoor activities can be performed, but certain precautions to avoid mosquitoes and ticks are recommended. Travel plans should be reviewed with the NP to ensure immunizations are up-to-date and further specialized immunizations or medications are not warranted.[5]

Latent viruses such as cytomegalovirus (CMV), herpes simplex, and Epstein-Barr virus (EBV) can be reactivated when the immune system is suppressed due to antirejection medications. CMV is the most common opportunistic infection post-LT.[3] It has been documented that CMV infection can activate rejection. Unfortunately, the medications used to treat rejection can stimulate viral replication of CMV.[2] CMV infection has been shown to have a direct and indirect relationship with posttransplant outcomes.[6] CMV infection is most common in the first 4 months posttransplant, and patients at highest risk are those who are CMV seronegative and received a CMV seropositive donor organ. This is called a CMV mismatch. Patient signs and symptoms can include headaches, fever, fatigue, myalgia, pancytopenia, nausea, and diarrhea.[2]

Treatment should be aggressive to prevent organ failure if there is tissue or organ involvement (CMV colitis, CMV pneumonitis, CMV hepatitis, or CMV nephritis). Serum CMV polymerase chain reaction can be obtained to confirm active viral replication of CMV. Tissue involvement must be confirmed by biopsy of the suspected organ affected.[6,7] Patients are hospitalized and usually treated with I.V. ganciclovir initially followed by a 6-to-8-week course of valganciclovir. (It should be noted that the FDA has not approved use of valganciclovir in LT patients. It is, however, widely used for LT patients in the clinical setting. NPs should seek expert opinion from a transplant hepatologist in these circumstances.) Patients with tissue involvement need a longer course of treatment. Foscarnet (off-label use post-LT) can be used for treatment in cases of ganciclovir-resistant CMV infection. This medication requires close monitoring due to it causing severe electrolyte abnormalities, kidney dysfunction, anemia, and even seizures.[6]

Posttransplant in EBV infection can range from mild to severe and can occur from 6 months to 4 years posttransplant.[2,3] Severe cases can lead to posttransplant lymphoproliferative disease (PTLD).[2] PTLD will develop in 2% of adult transplant patients.[2] Clinical presentation for PTLD can include fever, malaise, night sweats, and weight loss. Prompt consultation with a hematologist/oncologist is important to start chemotherapy if clinically indicated. Immunosuppression should be minimized.[7]

Other infection considerations. If the patient received a hepatitis B core positive donor or received a transplant because of hepatitis B-related cirrhosis, antiviral medications, and in some cases, hepatitis B immune globulin will be started to avoid active reinfection of the donor liver or graft.[7,8]

Patients who have hepatitis C will likely reinfect the graft.[4] According to Howell and colleagues, approximately 30% of hepatitis C LT patients will develop hepatitis C-related cirrhosis in 5 years.[9] Antiviral therapy will likely be necessary at some point posttransplant.[4] Treatment can be started sooner than ever before, and outcomes are hopeful for full clearance of hepatitis C infection with the availability of newer, interferon-free, antiviral medications.[3]

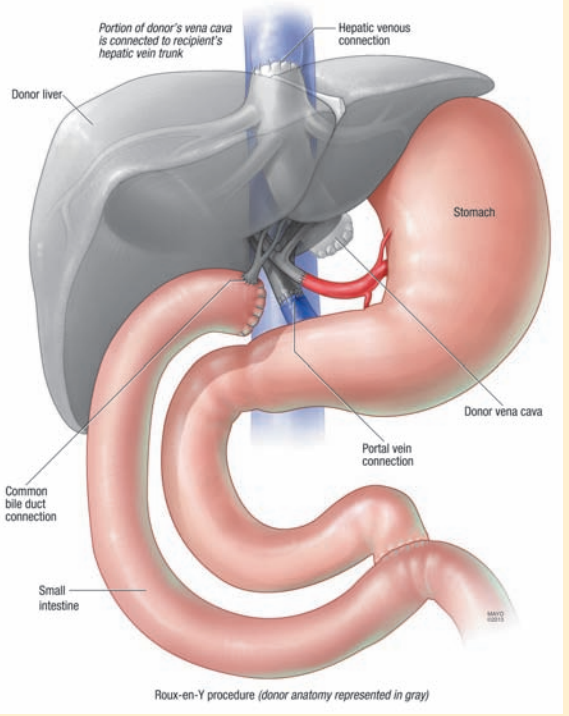
Common reasons for LT[4,5,7]

- Viral hepatitis (A, B, C)
- Alcohol-induced liver injury
- Autoimmune hepatitis
- Cryptogenic cirrhosis
- Nonalcoholic steatohepatitis
- Fulminant liver failure
- Hepatocellular carcinoma
- Cholangiocarcinoma
- Biliary diseases (including primary biliary cirrhosis or primary sclerosing cholangitis)
- Genetic diseases (including alpha-1 antitrypsin deficiency, amyloidosis, cystic fibrosis)
- Veno-occlusive disease
- Pediatric diseases (for example, biliary atresia)
- Primary nonfunction
- Hepatic artery thrombosis

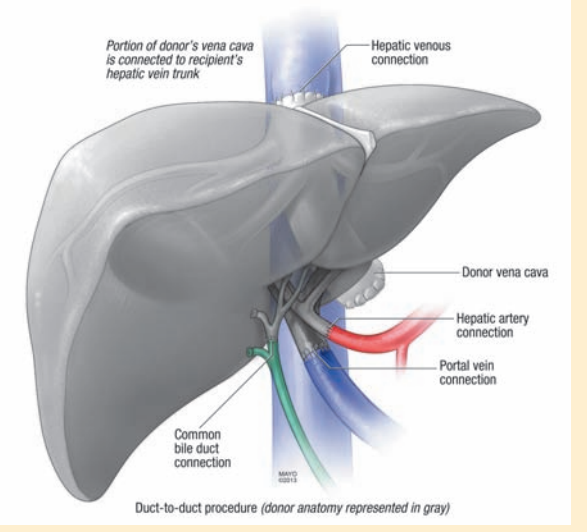
Primary care complications with LT considerations

It is essential for patients to remain on immunosuppression medications in order to prevent rejection. Primary care NPs are in a beneficial role to educate patients on the importance of committing to their medication regimen and making good lifestyle choices. Common immunosuppressant medications include calcineurin inhibitors (CNIs [tacrolimus and cyclosporine]), sirolimus and/or everolimus, antimetabolites (meant to be adjunctive to CNIs); azathioprine (AZA) and/or mycophenolate mofetil (MMF), and/or corticosteroids. Certain foods and/or other drugs (for example, grapefruit juice, carvedilol, diltiazem, isoniazid, rifampin, verapamil, warfarin, and fluconazole) can have interactions with CNIs, making it difficult for providers to maintain ideal therapeutic levels.[3,7,8,10] Frequent trough levels of CNIs and/or sirolimus/everolimus are necessary to maintain

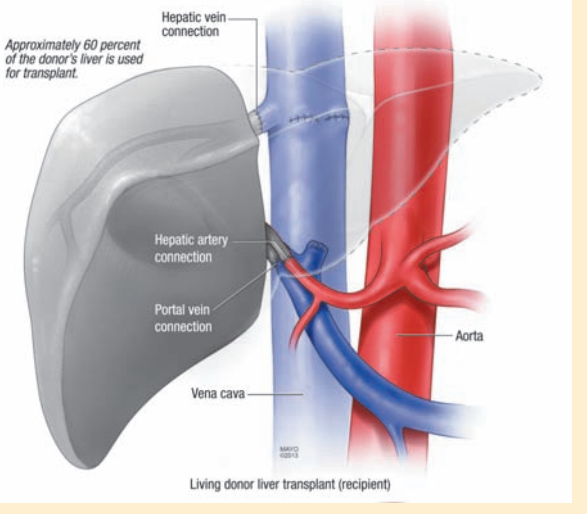
Liver transplantation: Roux-en-Y anastomosis



Liver transplantation: duct-to-duct anastomosis



Liver transplantation: living donor



proper therapeutic levels. This can and should be monitored by the patient's transplant center.

Cardiac issues. Post-LT patients are at risk for developing cardiovascular disease similar to the general population. Proper management of risk factors is important to prevent further development of cardiovascular disease. The United States Preventive Services Task Force (USPSTF) currently recommends administrating aspirin when there is limited risk of gastrointestinal bleeding to reduce the risk of myocardial infarction in men age 45 to 79, and to reduce the risk of ischemic stroke in women age 55 to 79. (The USPSTF recommendation, *Aspirin for Prevention of Cardiovascular Disease*, is currently under revision, and is available at: www.uspreventiveservicestaskforce.org/uspstf/uspsasmi.htm). Initiating aspirin would be reasonable 4 to 6 months after transplant in appropriate patients who have had a successful LT.

Hypertension. Hypertension is one of the most common complications post-LT, occurring in 55% to 85% of patients.[8] Calcineurin inhibitors (CNIs) and corticosteroid medications stimulate the patient's fight/flight responses and elevation in BP, vasoconstriction of the renal vasculature; resultant sodium retention can occur.[7,8,13] Ideally, the treatment of hypertension should be a target goal of a BP of 130/80.[5] Diuretics are useful in the initial postoperative setting to help remove excess volume.[8] Spironolactone is not recommended due to the high possibility of hyperkalemia with concurrent CNI use.[7] Certain calcium channel blockers, such as amlodipine and nifedipine, are preferred first-line agents for the LT patient with hypertension.[14] Amlodipine, a calcium channel blocker, promotes direct vasodilation and is a reasonable

option. This medication may increase cyclosporine levels but generally has minimal interactions with CNIs.[8,13]

Other calcium channel blockers, such as verapamil and diltiazem, are not recommended, as they can have drug-to-drug interactions with CNIs. Clonidine is an option, especially in a hypertensive emergency; however, it can worsen depression issues.[7,13] Beta-blockers are useful, especially in the initial postoperative setting, due to their cardioprotective effect. Carvedilol should be used with caution, as it too has drug-to-drug interactions with CNIs. Angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) can be used after the first 4 to 6 months posttransplant if issues with kidney dysfunction and hyperkalemia are resolved.[7,13] ACE inhibitors or ARBs are first-line choices for hypertension management in LT patients with diabetes, kidney disease, and/or proteinuria.[5]

Atrial fibrillation. Atrial fibrillation can occur postoperatively after LT surgery as with any surgery. One study revealed that LT patients with a prior history of atrial fibrillation were more likely to develop postoperative atrial fibrillation and perioperative cardiac events.[15] Surgery places high demands on the body's other organs. It is important for the heart to be strong enough to tolerate this kind of stress. Some risk factors associated with development of postoperative atrial fibrillation include electrolyte imbalances, advanced age, and prior atrial fibrillation episodes. Treatment is aimed at rate control. Beta-blockers or amiodarone are used initially to control heart rate.[16] Calcium channel blockers can be used with caution for the same reasons as mentioned above.[7,13] Amiodarone should not be used long term, and bolus doses can be associated with hepatotoxicity.[17,18]

Anticoagulation can be considered if the patient has persistent atrial fibrillation. There is a high risk of bleeding in the initial postoperative setting. Collaboration with transplant hepatologist and cardiologist is essential to determine if anticoagulation is appropriate for the individual patient.

Dyslipidemia. Research has documented that 43% to 66% of LT patients develop hyperlipidemia after LT.[8,14,19,20] Based on this information, LT patients should have lipid panel testing completed within the first 4 to 6 months after LT and annually thereafter.[14] Transplant medications that can cause dyslipidemia include cyclosporine, corticosteroids, sirolimus, and at certain times, modifications of these medications may be necessary.[5,8,10,19] Lifestyle modifications, including dietary changes, participation in an exercise program, and avoidance of smoking and alcohol consumption should be recommended in the initial treatment plan.[5,8,10] Medications may need to be decreased or modified if lifestyle changes do not decrease lipid levels.

Antidyslipidemic agents can be used in postoperative liver patients, but many have negative adverse reactions. Bile acid sequestrants, colestipol, and cholestyramine should not

Recommended studies for LT patients based on abnormalities[4,5,7]

Abnormality	Differential diagnosis	Recommended studies
• Elevated LFTs/ bilirubin levels • Fever, chills, abdominal pain • Jaundice	• Hepatic artery stenosis/ thrombosis • Biliary leak • Biliary strictures • Rejection • Infection	• Lab studies (CBC with differential, electrolytes, glucose, creatinine, BUN, phosphorus, alkaline phosphatase, ALT, AST, total bilirubin, direct bilirubin, PT/INR, blood cultures, CMV PCR • Abdominal Doppler ultrasound • MRCP • ERCP • PTC • Liver biopsy
• Pancytopenia	• Adverse reactions to medications (antivirals, sulfamethoxazole, and trimethoprim) • CMV infection	• Lab studies (CBC with differential, renal profile, LFTs, PT/INR, CMV PCR • Hematology/oncology consultation if pancytopenia is severe • Bone marrow biopsy if recommended by hematologist/ oncologist
• Fatigue • Lack of appetite • Weight loss	• Hepatocellular carcinoma • Cholangiocarcinoma • PTLD	• Lab studies (routine; same as above; add iron studies, vitamin A, D, zinc) • Liver biopsy • Hematology/oncology consultation • Bone marrow biopsy

AST - aspartate aminotransferase; **CBC** - complete blood count; **CMV** - cytomegalovirus; **ERCP** - endoscopic-retrograde cholangiopancreatography; **LFTs** - liver function tests; **MRCP** - magnetic resonance cholangiopancreatography; **PCR** - polymerase chain reaction; **PT/INR** - prothrombin time/International Normalized Ratio; **PTC** - percutaneous transhepatic cholangiography; **PTLD** - posttransplant lymphoproliferative disorder

be used with patients taking mycophenolate mofetil or medroxyprogesterone acetate. These anti-dyslipidemic agents will decrease those drug levels, making mycophenolate and medroxyprogesterone less effective.[7] Biliary sludge can develop in patients taking fibric acids, clofibrate, and gemfibrozil.[7] Hydrophilic statins (pravastatin) are recommended, as they have minimal drug-to-drug interaction with CNIs.[7,20] These medications can cause myopathy or elevated LFTs, so close monitoring and dose adjustments are recommended.[7]

Drug-to-drug interactions can occur when CNIs are used with lipophilic statins (atorvastatin, fluvastatin, lovastatin, pitavastatin, and simvastatin). The American Association for the Study of Liver Diseases recommends dietary and lifestyle modifications first for patients with dyslipidemia. The AASLD recommends the use of statins for dyslipidemia with the addition of ezetimibe for uncontrolled dyslipidemia. Fish oil (up to 4 g per day) is recommended for patients with elevated triglycerides.[5] Careful monitoring of liver function and adverse reactions is imperative if any of these medications are prescribed.[5,7,8,10]

Electrolyte imbalances. Patients will frequently need electrolyte replacements in the postoperative period. Prompt correction is required to prevent dysrhythmias. Hypomagnesemia, hypokalemia, and hypocalcemia are frequent problems, likely due to pretransplant malnutrition, inadequate dietary intake, and fluid shifts due to fluid losses and rapid fluid intake.[4,21] Hypophosphatemia is common because phosphorus is used to support the process of liver repair and regeneration. CNIs and kidney dysfunction can cause an increase in serum potassium levels, so potassium replacement should be given cautiously.[4]

Kidney problems. Kidney dysfunction is more common in LT patients than in other solid organ transplant patients. Mortality is significantly higher in patients with kidney dysfunction posttransplant than those with normal kidney function. Risk factors for developing worsened kidney function posttransplant include kidney status prior to surgery (presence of existing damage), hypertension, diabetes, and immunosuppression.[7]

Common strategies to enhance kidney function include optimal fluid balance, safely minimizing immunosuppression to allow for renal recovery, adding another immunosuppressant (MMF or azathioprine) if needed, and avoidance of nephrotoxic medications (nonsteroidal anti-inflammatory drugs) or I.V. pyelogram contrast material.[5,7,13] Consulting a nephrologist is recommended if the patient has presence of proteinuria, hematuria, or rapidly worsened creatinine/blood urea nitrogen/glomerular filtration rate.[5,7]

Diabetes. LT patients are given corticosteroids to reduce the risk of rejection. Doses are initially high and are then gradually tapered down and sometimes stopped 4 to 6 months after transplant. The adverse reaction of these medications can cause hyperglycemia, inducing a state of diabetes in these patients. The trauma from surgery and physiologic stress can also contribute to a hyperglycemic state.[10,21] Post-LT patients must be taught how to test their blood glucose levels for glucose abnormalities and, if required, give themselves the necessary amount of insulin before meals.

Most patients' blood glucose levels stabilize and they no longer need insulin as they are weaned off of corticosteroid medications. For patients with diabetes, oral diabetes agents (metformin, sulfonylureas [glimepiride, glyburide], and a thiazolidinedione [rosiglitazone]) can be reintroduced slowly after one to two postoperative months with close monitoring.[5] Use of thiazolidinediones in post-LT patients has not been safely established.[5] Treatment goals are the same as with any patient with diabetes and include achieving optimal blood glucose and hemoglobin A1C (less than 7%) levels, making lifestyle modifications, and minimizing complications (nephropathy, neuropathy, retinopathy, and cardiovascular events).

Nutrition considerations. Obese patients (body mass index greater than 30) are at higher risk for infection and delayed wound healing postoperatively. As post-LT patients feel better, they may improve their nutritional intake and overeat.[7] In addition, posttransplant medications, such as corticosteroids, may promote appetite stimulation, which can contribute to obesity.[10] Patients should be told to initiate wise nutritional choices and should participate in an aerobic exercise program.[7,8,23] Rapid weight loss programs and other fad diets are not recommended. Patients who have been severely malnourished pretransplant will likely require enteral feedings postoperatively. Optimal nutrition with adequate amounts of calories and protein has been associated with better postsurgical outcomes and improved wound healing.[23]

Gout. Reduced excretion of uric acid is a adverse reaction of CNIs. As a result, hyperuricemia is common after transplant and can be worsened by low-dose aspirin, thiazide diuretics, and niacin. Corticosteroids and colchicine are recommended for an acute gout attack. NSAIDS are not recommended due to renal issues if taken with CNIs. Allopurinol can be given, although prevention measures are needed. Allopurinol can increase serum levels of AZA, causing toxicity, and therefore, they should not be given together.[7,8,14] Febuxostat has been FDA approved for the treatment of chronic hyperuricemia in patients with gout. Febuxostat is contraindicated in patients taking azathioprine or mercaptopurine.[24] Its use cannot be recommended in this patient population without clear evidence of this medication's safety in LT. Consultation with a rheumatologist can help guide the NP to an ideal treatment strategy.

Bone disease issues. Patients with chronic liver disease frequently have a degree of bone loss pretransplant due to vitamin and nutrition deficiencies. There has been longstanding evidence that patients with cholestatic liver disease have the highest incidence of osteoporosis and are at high risk for fractures.[25-27] Vitamin D deficiency occurs in approximately 96% of patients awaiting LT.[28] With the addition of corticosteroids, postoperative bone loss occurs at a rapid rate for the first 3 to 4 months posttransplant, making these patients at high risk for osteopenia and osteoporosis.[5,8,27] A dual energy X-ray absorptiometry scan should be performed annually to evaluate possibility of (or worsened) osteoporosis, especially in the first 5 years after LT.[5] Vitamin D deficiency (25-hydroxyvitamin D levels less than 30 ng/mL) should be identified and treated.[5] Bisphosphonates can and should be considered once vitamin D levels are restored to a normal level.[29] Patients should remain on calcium and vitamin D supplementation in addition to their balanced dietary intake.[7] Additional vitamin D supplementation may be needed if a deficiency is noted. Weight-bearing exercises are recommended as well.[5]

Disease prevention strategies. Post-LT patients should have their immunizations up-to-date prior to the transplant surgery. This is usually monitored by the transplant center. Inactivated immunizations should be given if vaccinations are necessary. According to the USPSTF, routine exams should be performed as with any other patient, including breast and prostate exams, mammograms, GYN exams and Pap smears, colonoscopy, and proper screening for dyslipidemia, hypertension, diabetes, thyroid disorders, and malignancies.[7,8] The patient should make routine dental visits for cleanings and prompt attention of dental cavities to reduce the risk of infection.[8] Literature has noted the incidence of gingival hypertrophy in patients taking cyclosporine for immunosuppression.[7] Smoking and alcohol consumption should be discouraged. Patients should be counseled on cessation methods. Smoking after LT has been associated with significant adverse reactions, including graft loss and head, neck, and throat cancers.[5,7]

Patients are at higher risk for skin cancers in the postoperative setting, especially in the first 3 to 5 years. Annual skin checks are recommended, and suspicious lesions should be evaluated by a dermatologist.[7,8] Sirolimus has been shown to have a decreased association with skin cancers, so immunosuppression could be converted if clinically indicated.[7] Patients should be counseled on proper sunscreen use for prevention of skin cancers.[5]

Psychosocial/psychiatry concerns. Psychosocial issues are another concern in the posttransplant patient. Antirejection medications, especially corticosteroid medications, can cause emotional lability. Prompt recognition of depression and anxiety issues is important. Psychiatric consultation may be necessary to promote wellness in these patients. Selective serotonin reuptake inhibitors are first-line antidepressant agents for this patient population. Sertraline and citalopram have specifically been used effectively for LT patients and have minimal drug-to-drug interactions with CNIs.[14]

Posttransplant reproductive concerns. Close monitoring of the patient is essential for an optimal outcome for the mother and child. Twelve months is the recommended time frame from transplant to conception, and pregnancy complications are more common in these patients than the general population. MMF and AZA are pregnancy category D medications, so these medications should be discontinued prior to consideration of pregnancy.[5,7] If the patient becomes pregnant while taking mycophenolate, she must report this to her provider. The provider must then report to the Mycophenolate Pregnancy Registry.[30] Sildenafil can be prescribed for male patients with erectile dysfunction if there are no contraindications.[5] An increase in free testosterone levels in post-LT male patients has been noted.[24,25] Complete recovery of sexual and reproductive function may not occur.[5,31,32]

Moving forward

Patients after LT have similar issues to the general population with advancing age. There is higher risk of hypertension, diabetes, and dyslipidemia with advancing age along with increased risk for cardiovascular disease and events. The provider should aim to minimize these risks. Patients should make realistic goals and make lifestyle changes if and when one or more of these illnesses are present. As with any patient, health promotion and disease prevention are key elements in the care for LT patients.[10] NPs are ideal providers to assist these patients in long-term survival.

REFERENCES

1. Organ Procurement and Transplantation Network. Scientific Registry of Transplant Recipients annual data report 2012. optn.transplant.hrsa.gov/latestData/rptData.asp.
2. Cupples SA. Transplant infectious disease: implications for critical care nurses. *Crit Care Nurs Clin North Am.* 2011;23(3):519-537.
3. Razonable RR, Findlay JY, O'Riordan A, et al. Critical care issues in patients after liver transplantation. *Liver Transpl.* 2011;17(5):511-527.
4. Rudow DL, Goldstein MJ. Critical care management of the liver transplant recipient. *Crit Care Nurs Q.* 2008;31(3):232-243.
5. Lucey MR, Terrault N, Ojo L, et al. Long-term management of the successful adult liver transplant: 2012 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. *Liver Transpl.* 2013;19(1):3-26.
6. Sampathkumar P, Paya CV. Management of cytomegalovirus infection after liver transplantation. *Liver Transpl.* 2000;6(2):144-156.
7. McGuire BM, Rosenthal P, Brown CC, et al. Long-term management of the liver transplant patient: recommendations for the primary care doctor. *Am J Transplant.* 2009;9(9):1988-2003.

8. McCashland TM. Posttransplantation care: role of the primary care physician versus transplant center. *Liver Transpl.* 2001;7(11 suppl 1):S2-S12.
9. Howell J, Angus P, Gow P. Hepatitis C recurrence: the Achilles heel of liver transplantation. *Transpl Infect Dis.* 2014;16(1):1-16.
10. Reuben A. Long-term management of the liver transplant patient: diabetes, hyperlipidemia, and obesity. *Liver Transpl.* 2001;7(11 suppl 1):S13-S21.
11. Hall SL, Lorenc T. Secondary prevention of coronary artery disease. *Am Fam Physician.* 2010;81(3):289-296.
12. Wolff T, Miller T, Ko S. Aspirin for the primary prevention of cardiovascular events: an update of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2009;150(6):405-410.
13. Gonwa TA. Hypertension and renal dysfunction in long-term liver transplant recipients. *Liver Transpl.* 2001;7(11 suppl 1):S22-S26.
14. Singh S, Watt KD. Long-term medical management of the liver transplant recipient: what the primary care physician needs to know. *Mayo Clin Proc.* Aug 2012;87(8):779-790.
15. Bargehr J, Trejo-Gutierrez JF, Rosser BG, et al. Liver transplantation in patients with atrial fibrillation. *Transplant Proc.* 2013;45(6):2302-2306.
16. Vannucci A, Rathor R, Vachharajani N, Chapman W, Kangrga I. Atrial fibrillation in patients undergoing liver transplantation-a single-center experience. *Transplant Proc.* Jun 2014;46(5):1432-1437.
17. Verhovez A, Elia F, Riva A, Ferrari G, Apra F. Acute liver injury after intravenous amiodarone: a case report. *Am J Emerg Med.* Sep 2011;29(7):843 e845-846.
18. von Vital JM, Karachristos A, Singhal A, Thomas R, Jain A. Acute amiodarone hepatotoxicity after liver transplantation. *Transplantation.* Apr 27 2011;91(8):e62-64.
19. Gisbert C, Prieto M, Berenguer M, et al. Hyperlipidemia in liver transplant recipients: prevalence and risk factors. *Liver Transpl Surg.* 1997;3(4):416-422.
20. Charlton M. Obesity, hyperlipidemia, and metabolic syndrome. *Liver Transpl.* Nov 2009;15 Suppl 2:S83-89.
21. Grogan TA. Liver transplantation: issues and nursing care requirements. *Crit Care Nurs Clin North Am.* 2011;23(3):443-456.
22. American Diabetes Association. Standards of medical care in diabetes—2014. *Diabetes Care.* Jan 2014;37 Suppl 1:S14-80.
23. Johnson TM, Overgard EB, Cohen AE, DiBaise JK. Nutrition assessment and management in advanced liver disease. *Nutr Clin Pract.* 2013;28(1):15-29.
24. Chaichian Y, Chohan S, Becker MA. Long-term management of gout: nonpharmacologic and pharmacologic therapies. *Rheum Dis Clin North Am.* May 2014;40(2):357-374.
25. Trautwein C, Possienke M, Schlitt HJ, et al. Bone density and metabolism in patients with viral hepatitis and cholestatic liver diseases before and after liver transplantation. *Am J Gastroenterol.* 2000;95(9):2343-2351.
26. Lindor KD. Management of osteopenia of liver disease with special emphasis on primary biliary cirrhosis. *Semin Liver Dis.* 1993;13(4):367-373.
27. Guichelaar MM, Kendall R, Malinchoc M, Hay JE. Bone mineral density before and after OLT: long-term follow-up and predictive factors. *Liver Transpl.* 2006;12(9):1390-1402.
28. Crawford BA, Labio ED, Strasser SI, McCaughan GW. Vitamin D replacement for cirrhosis-related bone disease. *Nat Clin Pract Gastroenterol Hepatol.* 2006;3(12):689-699.
29. Ebeling PR. Approach to the patient with transplantation-related bone loss. *J Clin Endocrinol Metab.* 2009;94(5):1483-1490.
30. Information for Prescribers. 2012. https://www.mycophenolaterems.com/HCPOverview.aspx.
31. Burra P, Germani G, Masier A, et al. Sexual dysfunction in chronic liver disease: is liver transplantation an effective cure? *Transplantation.* 2010; 89(12):1425-1429.
32. Ho JK, Ko HH, Schaeffer DF, et al. Sexual health after orthotopic liver transplantation. *Liver Transpl.* 2006;12(10):1478-1484.

Amanda Chaney is a nurse practitioner at Mayo Clinic, Department of Transplant, Jacksonville, Fla.

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