CONSIDERATIONS FOR THE ADULT LIVER TRANSPLANT RECIPIENT

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Liver transplantation (LT) is the treatment of choice for conditions resulting in end-stage liver disease and acute liver failure. According to the Organ Procurement and Transplantation Network (OPTN), from January 1, 1988, to October 31, 2014, 131,669 persons (117,061 over age 18) underwent LT in the United States. In 2013, 5,921 adult liver transplants were performed (OPTN data as of 1/30/15).

Outcomes following liver transplantation surgery continue to improve. According to the 2013 OPTN/SRTR Annual Data Report, approximately 82% of adult LT recipients were alive 5 years after transplantation and 68% were alive 10 years after transplantation (from deceased and living donors). According to Lucey et al., as of December 30, 2011, there were approximately 60,000 LT recipients who were alive and who had survived at least five years, and more than 16,000 who had survived at least 10 years. During the first post-transplant year, approximately 60% of deaths that occur are due to infection, acute rejection or peri-operative/post-operative complications (Lucey et al., 2013). Thereafter, the cause of mortality shifts. After the first post-transplant year and through the first 10 years following transplantation, the incidence of mortality (or need for retransplantation) due to acute or chronic rejection remains low (Lucey et al., 2013). For those who underwent transplantation because of Hepatitis C or autoimmune liver disease, mortality due to recurrence of the pre-transplant condition is significant over time. However, the majority of deaths is attributed to an increased and accelerated course of cardiovascular disease and/or malignancy, results of the side effects of ongoing immunosuppression to prevent organ rejection (Stravitz, Carl & Biskobing, 2011; Lucey et al., 2013).

ROUTINE TREATMENT AND SURVEILLANCE FOR LT PATIENTS

The period leading up to a transplant includes treatment for the underlying medical issues; evaluation for transplant readiness; and procurement of the donor organ. The 2014 Milliman Research Report provides a summary of the estimated U.S. average costs and utilization related to the 30 days prior to admission for transplant, including organ procurement. The report includes all medical costs (billed charges) associated with the transplant patient (not just the transplant procedure), including diagnostics and physicians fees. (Bentley, 2014)

Milliman also provides a summary of the estimated average costs for the transplant admission and for the 180 days post-discharge. Routine care in the first six months following surgery includes physician visits, diagnostics and medications. Complications are most likely to occur in the immediate post-operative period. Immediate risks can include graft loss; acute rejection; and vascular complications such as hepatic artery or portal vein stenosis and thrombosis; hepatic outflow obstruction; and biliary complications. Additional risks associated with surgery and the perioperative period can include bleeding, sepsis, respiratory failure, pneumonia, encephalopathy, acute renal failure or other organ failure. The LT recipient requires a period of intensive care, with gradual reduction of supportive treatment based upon medical stability. Ongoing care will be patient-specific and according to the postoperative course.

Outpatient follow up with members of the transplant team (hepatologist, transplant coordinator, clinical nurse specialist, dietician, social worker and/or pharmacist) would be scheduled per the protocol of the specific transplant center. Some routine care might be transferred back to the primary care provider, but close contact with the transplant team must be maintained. Laboratory tests, to monitor renal function, hepatic function, drug levels and the effects of medications, must be done regularly; however, the frequency would be based upon health status, liver function and center-specific protocols. When the transplant hospital is a distance from the patient’s home, studies might be obtained in the patient’s community and monitored remotely by the transplant team.

In 2013, the American Association for the Study of Liver Diseases and the American Society of Transplantation published guidelines for the long-term management of adults who had successfully undergone LT. The authors emphasized that the practice guidelines are intended to be flexible and suggest “preferred” approaches to the diagnostic, therapeutic and preventative aspects of care to identify and ameliorate the barriers to maintaining health (Lucey et al., 2013; Mells & Neuberger, 2009). Each patient will have his or her own subset of medical issues, based upon any pre-existing comorbidities and the post-transplant course. If the issues are results of the transplant, costs should be included in the Life Care Plan projection. If issues are due to pre-existing comorbidities, the costs should not be included.

Nurse Life Care Planners must address ongoing surveillance of the liver transplant, long-term consequences of the procedure itself, and the side effects of immunosuppression and other treatments necessary to maintain the transplant. The literature emphasizes the importance of early recognition of risk factors to avoid long-term complications of immunosuppression and recurrent liver disease (Stravitz, Carl & Biskobing, 2011; Lucey et al., 2013; Mells & Neuberger, 2009).

Medications: There is no single medication protocol recommended for all patients. Since there is no reliable marker for measuring effective levels of immunosuppression, the choice of agents and dosage will be dependent upon clinical, laboratory and histologic response (Lucey et al., 2013). According to Lucey et al., immunosuppressants are known to cause or accelerate cardiovascular disease and/or malignancy; they make the LT recipient especially vulnerable to metabolic syndrome and renal
Early and aggressive treatment is essential, as is the minimization of possible infectious exposure. The patient must avoid exposure to seemingly innocuous colds and ailments, which means limiting attendance at events in public places or where there are large crowds of people. When the LT recipient seems lethargic, has a fever or has decreased appetite, he should usually be evaluated for rejection or infection. Patients are particularly at risk for infection when dosages of immunosuppressants are increased; during the first three to six months post-transplant; and during treatment for signs of rejection. Opportunistic infections are often due to herpes viruses (EBV, CMV, simplex and zoster), fungi (Candida, Aspergillus, Cryptococcus), unusual bacteria (Nocardia, Listeria) and mycobacteria (Lucey et al., 2013). The transplant center should be consulted regarding medications to treat symptoms. Many drugs are contraindicated because of drug-drug interactions or liver toxicity. Diagnostic testing would be based upon symptoms and transplant center protocol.

Rejection: The body reacts to the foreign liver through a multi-step immune response (alloantigen recognition, lymphocyte activation, clonal expansion and graft inflammation), resulting in acute rejection. Immunosuppression is necessary to thwart this process. Several months post-transplant, the transplanted liver becomes partially tolerant of injury associated with the immune response; thus, the need for immunosuppression declines. However, the majority of LT recipients continue to require lifelong immunosuppression; maintenance without immunosuppressant medications is rare (Lucey et al., 2013). The continued use of immunosuppression has inevitable consequences, including an increased risk of infections, metabolic complications, and hepatobiliary or extrahepatic de novo (new) cancers (Lucey et al., 2013).

**COMMON COMPLICATIONS FOLLOWING LIVER TRANSPLANT**

**Infection:** The LT recipient must be monitored closely for signs of infection. Early and aggressive treatment is essential, as is the minimization of possible infectious exposure. The patient must avoid exposure to seemingly innocuous colds and ailments, which means limiting attendance at events in public places or where there are large crowds of people. When the LT recipient seems lethargic, has a fever or has decreased appetite, he should usually be evaluated for rejection or infection. Patients are particularly at risk for infection when dosages of immunosuppressants are increased; during the first three to six months post-transplant; and during treatment for signs of rejection. Opportunistic infections are often due to herpes viruses (EBV, CMV, simplex and zoster), fungi (Candida, Aspergillus, Cryptococcus), unusual bacteria (Nocardia, Listeria) and mycobacteria (Lucey et al., 2013). The transplant center should be consulted regarding medications to treat symptoms. Many drugs are contraindicated because of drug-drug interactions or liver toxicity. Diagnostic testing would be based upon symptoms and transplant center protocol.

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**IMMUNOSUPPRESSION**

Immunosuppression can be achieved with various medication protocols, including calcineurin inhibitors (CNIs), corticosteroids and / or adjuvant agents. Liver transplantation is unique in that the risk of rejection decreases over time, and the need for immunosuppression might decrease. However, maintenance without immunosuppression is rare (Lucey et al., 2013). The immunosuppressant regimen would be reviewed periodically. Blood levels for certain medications would be drawn regularly (center-specific frequency; might decrease with stable dose).

Calcineurin inhibitors (primarily cyclosporine A and tacrolimus) are the cornerstone of immunosuppressant therapy. Side effects include renal dysfunction, neurologic changes, diabetes, increased susceptibility to infections, and certain de novo (new) malignancies. The dosage of CNIs is determined by blood levels. Since these agents are metabolized in the liver by the cytochrome p-450 system, levels can become elevated or reduced by concomitant use of medications that either inhibit or compete with this system. Medications such as fluconazole, erythromycin, diltiazem, verapamil and protease inhibitors elevate CNI blood levels and potential toxicities, while barbiturates, phenytoin, rifampin and carbamazepine can lead to reduced CNI blood levels and insufficient immunosuppression.

**Corticosteroids** are particularly useful when used in conjunction with other agents. Side effects include weight gain, hypertension, hyperglycemia, hyperlipidemia, delayed wound healing, glaucoma, osteoporosis, growth suppression, fungal infections, pituitary-adrenal dysfunction and gastric ulcers. Due to these side effects, the treatment team will attempt to reduce or eliminate their use. However, appropriate medical surveillance by specialists (internists, ophthalmologists, etc.) should be part of the Life Care Plan, to ensure early detection of complications.

**Adjunctive Therapies** such as mycophenolate mofetil (CellCept) and sirolimus (Rapamune), enhance the effect of CNIs so that a lower dosage can be utilized. Adjunctive therapies are more commonly used in the early post-operative period so that initiation of CNIs can be delayed. The combination of sirolimus, an mTOR inhibitor, with low-dose CNIs helps to minimize renal injury. Sirolimus might also provide some protective benefit against certain malignancies. Antibody therapy (daclizumab, basiliximab, muromonab, alemtuzumab) is used during the peri-operative period to reduce the need for high-dose corticosteroids and to delay the introduction of CNIs. Unfortunately, these medications are not without their own side effects. Mycophenolate mofetil causes bone marrow suppression and gastrointestinal effects. Sirolimus causes leukopenia, thrombocytopenia, anemia, gastrointestinal disruptions and infections. Antibody therapy is associated with an increased incidence of opportunistic infections and cancers.
Surveillance of the LT recipient should be performed by those with knowledge and expertise in the many facets of transplantation and immunosuppression. The frequency of monitoring with liver tests would be individualized by the transplant center, depending upon complications and stability of serial laboratory results.

Early signs of rejection include fever, flu-like symptoms and abdominal pain or tenderness. Later symptoms, indicative of worsening liver function, might include jaundice, changes in urine / stool coloration, confusion, increased fatigue and ascites. Depending on the laboratory values and clinical picture, additional diagnostic testing could include MRI, CT, endoscopic retrograde cholangiopancreatography and / or sonography. The clinical suspicion of acute rejection requires confirmation by liver biopsy. Treatment of rejection would typically include an increase in immunosuppressant agents. Evaluation and treatment could also require inpatient hospital care.

Additional Complications: Table 1 shows the prevalence of some complications beyond the first post-transplant year.

<table>
<thead>
<tr>
<th>CARDIOVASCULAR RISK FACTOR</th>
<th>PREVALENCE RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic Syndrome*</td>
<td>50% - 60%</td>
</tr>
<tr>
<td>Systemic Hypertension</td>
<td>40% - 85%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>10% - 64%</td>
</tr>
<tr>
<td>Obesity</td>
<td>24% - 64%</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>40% - 66%</td>
</tr>
<tr>
<td>Chronic Kidney Disease (stage 3-4)</td>
<td>30% - 80%</td>
</tr>
<tr>
<td>End-Stage Kidney Disease</td>
<td>5% - 8%</td>
</tr>
</tbody>
</table>

*any 3 of the following: hypertension, obesity, dyslipidemia, diabetes

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Increased fat and ascites. Depending on the laboratory values and clinical picture, additional diagnostic testing could include MRI, CT, endoscopic retrograde cholangiopancreatography and / or sonography. The clinical suspicion of acute rejection requires confirmation by liver biopsy. Treatment of rejection would typically include an increase in immunosuppressant agents. Evaluation and treatment could also require inpatient hospital care.

Additional Complications: Table 1 shows the prevalence of some complications beyond the first post-transplant year.

- Metabolic Syndrome: The clinical features of metabolic syndrome, including hypertension, diabetes, obesity and / or dyslipidemia, contribute to post-transplant morbidity and mortality. Since these features could also be pre-existing comorbidities, careful consideration for the inclusion or exclusion of the costs of surveillance and treatment is essential.

- Hypertension: The development of hypertension after LT is primarily a consequence of immunosuppression and renal dysfunction (Mells & Neuberger, 2009). CNIs and corticosteroids have a deleterious effect on physiologic mechanisms, resulting in damage to the kidneys. Recommendations for treatment of hypertension should include therapeutic lifestyle changes, pharmacotherapy and adjustments to the immunosuppressant regimen.

- Diabetes Mellitus (DM): Glucocorticoids, CNIs (tacrolimus more than cyclosporin), Hepatitis C and metabolic syndrome are associated with the development of new onset diabetes and exacerbate pre-existing hyperglycemia or DM (Lucey et al., 2013). Drug interactions might limit choices for oral antidiabetic agents.

- Obesity: Weight gain is common following LT, the effect of restoration of health and of appetite stimulation associated with corticosteroids and other medications. Bariatric surgery is a consideration for those who become...
Dyslipidemia: Glucocorticoids, cyclosporin and sirolimus cause the greatest increases in total cholesterol, LDL and HDL. Management of dyslipidemia should include dietary modifications, and pharmacotherapy with lipid-lowering medications, such as statins, cholesterol absorption inhibitors, bile acid sequestrants, fibrates and niacin. Potential drug interactions might limit medication choices.

Metabolic Bone Disease: Accelerated bone loss, which occurs in the first few months post-transplant in almost all LT recipients, is attributed to corticosteroids and CNIs. Thereafter, there might be some recovery of bone loss. The risk for fracture is greatest during the first two years. Trabecular bone (ribs, vertebrae) is particularly vulnerable. Surveillance should include assessment of bone pain, dietary intake of protein and calcium, bone mineral density (BMD) with DEXA scans, and Vitamin D blood levels. Hormone levels and radiologic studies of the spine would be monitored with more advanced disease. Calcium and Vitamin D supplementation is recommended for LT recipients with osteopenia (or at risk for osteopenia); bisphosphonate therapy might be considered. (Lucey et al., 2013)

Malignancies: LT recipients have an overall higher risk of developing de novo malignancies than the general population (Chandok & Watt, 2012). Nonmelanoma skin cancers are the most common of all malignancies that occur in LT, with an incidence that is up to 20 times higher than age and sex matched non-transplant cohorts, and are much more aggressive in transplant recipients (Stravitz, Carl & Biskobing, 2011). Other cancers associated with immunosuppression include lymphoma, Kaposi’s sarcoma and those of the oropharynx, esophagus, lung and colon. Research has shown that more intensive surveillance results in diagnoses of cancers at earlier stages and, thus, in improved survival (Stravitz, Carl & Biskobing, 2011). Therefore, surveillance (dermatologist and / or other specialists) is recommended to begin at a younger age than the non-transplant population. For those with pre-existing co-morbidities such as inflammatory bowel disease, primary sclerosing cholangitis or cirrhosis, additional or more frequent screening could be needed (colonoscopy with biopsy, abdominal imaging, etc.) (Stravitz, Carl & Biskobing, 2011; Lucey et al., 2013).

ADDITIONAL CONSIDERATIONS IN THE LIFE CARE PLAN

Coping: Liver transplantation takes a significant toll on one’s emotional and psychological well-being. The LT recipient has endured invasive procedures and severe pain. Family roles and other relationships are changed. The ability to work, maintain one’s home without assistance or participate in many activities enjoyed prior to the transplant are altered. The LT recipient faces an uncertain future, which at best includes multiple additional procedures and could very well include a lifetime of chronic illness. Due to significant lifestyle changes imposed by the transplant and its follow-up care, counseling to assist with developing and maintaining coping skills should be considered for inclusion in the Life Care Plan.

Hospitalizations: Hospital care is often required for evaluation and treatment of complications. Treatment of infections often requires the administration of intravenous antibiotics and steroids. Early signs of organ rejection often require hospitalization. Inpatient care is also likely to include management of complications associated with medications specific to the transplant. Consideration for the inclusion of hospital care in the Life Care Plan should be made with sufficient medical foundation.

Mobility / Independent Function: Depending upon the medical course, the LT recipient might be severely deconditioned or have suffered complications resulting in mobility and / or functional deficits. The Life Care Plan should consider supportive care and equipment:

Assistance / Replacement Services: A Home Health Aide, assisted living or care in a nursing home might be required. Replacement services for those tasks the patient was able to perform prior to the LT should also be considered.

Equipment: Aids for mobility and / or activities of daily living, including canes, walkers, wheelchairs, a shower bench, lift chairs, reachers, etc., might be required.

Home Modifications: Modifications to address changes in mobility (negotiating stairs, reaching, bending, kneeling), hand strength / dexterity and / or bimanual function should be addressed.

Travel: The costs of lodging and travel to and from the transplant center, if the client lives a substantial distance away and could not rea-
reasonably attend an appointment and return home the same day, might be included in the Life Care Plan.

**COSTING CONSIDERATIONS**

Center-specific (rather than generic) costs best indicate future expenses. However, in many cases, a patient requiring transplant at some future time has not yet been enrolled in a transplant program, or the costs are not readily available. Published statistics, such as The Milliman Report, provide an accessible source for cost projections surrounding the transplant and the immediate pre- and post-operative periods.

The Life Care Planner should be cognizant of the pitfalls of using published statistics. Some pitfalls are noted below:
- use of group average; assuming every patient is the same
- failure to account for geographical differences
- inclusion of costs for comorbidity treatment
- failure to point out that high-volume centers might have more complex patients with higher average costs
- failure to take into consideration that changes in protocols occur faster than the literature relating to costs can reflect
- inclusion of studies that are either retrospective or were initiated years prior to completion

When addressing costs of retransplant, past billing is an excellent predictor of future costs.

Medical foundation from treating providers is helpful in projecting the frequency and duration of physician surveillance, diagnostics and medications.

**CONCLUSION**

The preparation of a Life Care Plan for a patient anticipating a liver transplant or recovering from a transplant is a challenge for even the most experienced Life Care Planner. Although there are many common elements for all transplant recipients, each patient will have his own set of needs. Each Plan should individualize the care to reflect accurately the case at hand.

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**NURSING DIAGNOSES TO CONSIDER**

- **INEFFECTIVE HEALTH MAINTENANCE:**
  Domain 1, Health Promotion; Class 2: Health Management

- **READINESS FOR ENHANCED HEALTH MANAGEMENT:**
  Domain 1, Health Promotion; Class 2: Health Management

- **RISK FOR OVERWEIGHT:**
  Domain 2, Nutrition; Class 1: Ingestion

- **RISK FOR UNSTABLE BLOOD GLUCOSE:**
  Domain 2, Nutrition; Class 4: Metabolism

- **RISK FOR IMPAIRED LIVER FUNCTION:**
  Domain 2, Nutrition; Class 4: Metabolism

- **RISK FOR ELECTROLYTE IMBALANCE:**
  Domain 2, Nutrition; Class 5: Hydration

- **RISK FOR ACTIVITY INTOLERANCE:**
  Domain 4, Activity/Rest; Class 4: Cardiovascular/Pulmonary Responses

- **RISK FOR COMPROMISED HUMAN DIGNITY:**
  Domain 6, Self-Perception; Class 1: Self-Concept

- **DISTURBED BODY IMAGE:**
  Domain 6, Self-Perception; Class 3: Body Image

- **ANXIETY:**
  Domain 9, Coping/Stress Tolerance; Class 2: Coping Responses

- **INEFFECTIVE COPING:**
  Domain 9, Coping/Stress Tolerance; Class 2: Coping Responses

- **RISK FOR POWERLESSNESS:**
  Domain 9, Coping/Stress Tolerance; Class 2: Coping Responses

- **RISK FOR INFECTION:**
  Domain 11, Safety/Protection; Class 1: Infection

NANDA-INTERNATIONAL NURSING DIAGNOSES, 2015 - 2017