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[SUMMARY BOX BEGINS]

Summary

This article provides an overview of the care and support for a patient following Liver transplantation. It focuses on the immediate post operative care, the role of the transplant coordinator in providing support and education and the long term follow up which is required in order to promote health and quality of life in this specific patient group.

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[Keywords] Graft rejection, immunosuppression, liver function and transplantation

[SUMMARY BOX ENDS]

[A HEAD] Aims and intended learning outcomes

The aim of this article is to provide an overview of the care of patients following Liver transplantation, including the role of the transplant coordinator in post-operative care and the factors that can influence recovery and outcomes. General critical care interventions will not be discussed in this article; care will be solely

focused on the patient undergoing liver transplantation. After reading this article and completing the time out activities you should be able to:

- Understand the need to assess liver function in patients following liver transplantation.
- Describe some of the major functions of the liver and how they are affected in the immediate post-transplant period.
- Identify immunosuppression medications commonly used in patients following liver transplantation and the consequences of long-term use.
- Recognise the importance of providing education and health advice to patients requiring liver transplantation.
- Discuss how illness beliefs could affect long-term health and survival in post-transplant patients.

[A HEAD] Introduction

The prevalence of liver disease has been continuously increasing over the last decade and is now the fifth leading cause of mortality in the UK (Office for National Statistics 2008). Viral hepatitis along with alcohol abuse are the most common causes of chronic liver disease in Europe; with an increasing occurrence of non-alcoholic fatty liver disease as a result of changing lifestyles (Nikolopoulos and Oben 2009). Liver transplantation is often required for patients with end-stage liver disease and success rates of this procedure have increased as a result of both surgical techniques and immunosuppression drugs (Clayton 2007, Geissler and Schlitt 2009). Post-transplant survival rates are now as high as 89% at one year (UK Transplant). However many complications can occur following transplantation, particularly in the early post-operative period (Levesque *et al* 2009).

[A HEAD] Immediate post-transplant care

All patients following liver transplantation require specialist critical care in the immediate post-operative period. Depending on the patient's health status before transplant, the type of transplant performed and the occurrence of peri-operative complications, the critical care length of stay can vary. Immediate post-liver transplantation complications include (Benten *et al* 2009):

- Primary graft non function.
- Acute organ rejection.
- Infection.
- Biliary leaks.
- Hepatic artery thrombosis.

The medical and nursing team who is responsible for the care of these patients must be able to recognise these complications and manage them appropriately. Therefore much of the post-operative care of patient following liver transplantation involves close monitoring of graft function. Some of the common problems experienced by patients post-liver transplant and the management of these can be seen in Table 1.

Hemodynamic monitoring is essential to monitor and maintain cardiovascular stability. This is also important as the new liver requires sufficient perfusion to function effectively. Hemodynamic stability can be considered to be a sign of good graft function (Fan 2006) as poor graft function may be accompanied by metabolic acidosis and hypotension. The nurse is in an ideal position to monitor cardiovascular parameters, document findings and act on results to maintain blood pressure at a level sufficient for organ perfusion. Research does not conclusively identify the most effective fluid used for improving organ perfusion, with both starch and gelatine-based colloids having similar effects on blood volume and liver perfusion (Inal *et al* 2010). The choice of fluid is therefore left to the discretion of the medical and nursing teams caring for the post-transplant patient.

Table 1 Standard post-liver transplant care in the critical care area

Problem	Cause	Action
Low Hemoglobin level	Blood loss Haemodilution from colloid/crystalloid administration	Red blood cell administration to achieve Hb \geq 7g/l (Hebert <i>et al</i> 1999) Observe wound and drain sites for bleeding
Electrolyte imbalance	Red blood cell transfusion Insensible fluid losses Renal dysfunction Liver cell recovery	Regular blood level monitoring Supplements for low levels of phosphate/potassium/magnesium (Benten <i>et al</i> 2009)
Renal dysfunction	Hypoperfusion of kidneys peri-operatively	Hemodynamic monitoring Fluid/vasopressor administration Fluid balance monitoring

	Pre-operative renal dysfunction	Daily Creatinine levels to monitor renal function (Benten <i>et al</i> 2009)
Raised serum Lactate levels (>2mmols/l)	Hypoperfusion of tissues due to fluid/blood loss Liver dysfunction Renal dysfunction	Colloid/crystalloid administration to achieve adequate blood pressure (Inal <i>et al</i> 2010) Avoidance of Hartmann's solution administration Regular arterial blood gas monitoring for lactate levels
Infection risk (Pratschke <i>et al</i> 2008)	Liver dysfunction Invasive lines, catheters and wounds Immunosuppression drug administration	Strict infection control techniques by all members of the multidisciplinary team Prophylactic antibiotics, antifungal and antiviral agents may be required

Liver biochemistry needs to be monitored daily to identify graft dysfunction, rejection and hepatic artery thrombosis. The liver is the main site of most of the coagulation factor synthesis (Lisman *et al* 2002). Many of these coagulation factors have short half lives, for example factor VII has a half life of five hours (Sakka 2007). Therefore a change in international normalised ratio (INR) and prothrombin time (PT) can be seen over a short period of time. Blood clotting time may be prolonged immediately following liver transplantation, however as the new liver starts to function it can be expected that the INR and prothrombin time will slowly return to normal. Fan (2006) suggested that by day seven if the blood clotting time has not returned to normal then graft dysfunction should be suspected.

Aminotransferases can also be monitored daily. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are enzymes which are released from the liver cells (hepatocytes) when the cells become damaged (Green and Flamm 2002). Although AST is not specific to the liver, both AST and ALT can give an indication of graft function following liver transplantation. Bilirubin levels should also be monitored as part of the routine care of this patient group (Benten *et al* 2009).

These tests require blood to be sent to a laboratory and therefore do not measure liver function at the point of testing (Sakka 2007). Liver biochemistry following liver transplantation can be difficult to interpret which may delay the recognition of graft dysfunction (Levesque *et al* 2009) and results need to be assessed over a 72-hour period to obtain an accurate view of graft function. As a result, the recognition of liver dysfunction may be delayed (Olmedilla *et al* 2009). However, it is imperative the nurses caring for the patient are able to understand liver biochemistry and to monitor it on a daily basis.

[TIME OUT 1]

Time out 1

After reading the information presented above, consider the ways in which the nurse can prevent infection in the patient following liver transplantation.

[TIME OUT 1]

Dynamic tests which assess liver function at the point of testing are being increasingly used. A LiMON is a non-invasive technique used to assess liver function in the post-liver transplant patient. It requires the administration of indocyanine green (ICG), a water soluble dye which is taken up by hepatocytes and excreted in bile without any extrahepatic elimination (Olmedilla *et al* 2009). Once the ICG is given into the vein, the plasma disappearance rate of the dye can be measured using a finger probe over an eight-minute period. It is expected that the liver will remove the dye from the blood at a rate of 18%/min, which demonstrates good liver function (Sakka 2007). This method has been increasingly researched as a way in which liver function can be assessed following liver resection and liver transplantation. Levesque *et al* (2009) found that the plasma disappearance rate measured in the first five days following liver transplantation could predict the development of post-operative complications. The LiMON is a technique which the critical care nurse can easily learn with appropriate support and education and forms another way in which the nurse can monitor the graft function in this patient group.

There is evidence to support early enteral feeding in many critical care populations and it is thought to reduce complications, reduce intensive care stay and improve patient outcomes (Martindale *et al* 2009). Early enteral feeding via a naso gastric tube is usually commenced, unless the transplant operation has involved a procedure known as a Roux-en-y. This is performed when the patient's bile duct is too small to allow bile to drain from the transplanted liver. A Roux-en-y involves the resection of the Jejunum which is anastomosed to the liver for the drainage of bile (Kinkhabwala and Crawford-Edmond 2000). If this has been performed then the patient will be nil-by-mouth for five days, to allow the bowel to rest and prevent any problems arising from the anastomosis. Intravenous crystalloids would be given for the five days until feeding commences.

The liver plays a vital role in the storage and release of glucose when required. In liver dysfunction, hypoglycaemia often occurs as a result of hepatocyte damage. Post-liver transplant blood sugars may be deranged as the new liver graft starts to function. A blood sugar of <10mmols/l has been found to improve outcome in patients in the critical care environment (Finfer *et al* 2009). For these reasons, routine care following liver transplantation would include an infusion of actrapid, titrated to achieve a blood sugar of between 4-10mmol/l. Care must be taken to

avoid evoking hypoglycaemia, which has been found to be independently associated with increased mortality (Van den Berghe *et al* 2006).

[TIME OUT 2]

Time out 2

Consider the information presented above regarding blood tests. List those that show liver function (the ability to make something) and those that show liver damage.

[TIME OUT 2]

The experience of staying in intensive care can be traumatic as patients experience being monitored closely at all time, constantly surrounded by electronic equipment and noises, and attached to multiple measurement devices. Numerous studies have investigated patient experience and recovery following a period in an intensive care (Dowdy *et al* 2005) and several systematic reviews have demonstrated delayed and prolonged physical and psychological recovery, often beyond six months after discharge (Elliott *et al* 2006). Research also shows that discharge from intensive care can be seen by many patients as the start of an uncertain journey of recovery, with many patients experiencing post traumatic stress disorder as a result of their experiences. Patients who experience post-traumatic syndrome following their stay in intensive care report a negative effect on their quality of life (Davydow *et al* 2008).

Nurses caring for patients following liver transplantation should recognise those patients who are at risk of post-traumatic syndrome and monitor their needs for early intervention. The National Institute of Health and Clinical Excellence (NICE) (2009) outline optimal rehabilitation after critical care and recommend that before discharge from intensive care, a comprehensive multidisciplinary assessment should evaluate physical and psychological problems including intensive care acquired weakness, and sensory, communication, cognitive and functional disabilities. Patients with, or at risk of, such problems should receive early tailored rehabilitation plans. Rehabilitation progress should be regularly reviewed on the ward, and after hospital discharge. At hospital discharge, key information should be provided to patients, their carers and their primary care physician about physical recovery and how to manage activities of daily living, including plans for follow up.

[TIME OUT 3]

Time out 3

Think about the role of the transplant co-ordinator. Outline the aspects of this role that you consider to be essential in the care of patients following liver transplantation. Now compare your answer to the information presented below.

[TIME OUT 3]

[A HEAD] Preparing the patient for hospital discharge

All patients receiving a liver transplant will require lifelong immune-suppression medication to prevent rejection of the transplanted graft. The doses of these drugs are tailored to the individual's needs to ensure the best function of the newly implanted liver. Care must be taken to minimise the adverse effects that can result from excessive immune-suppression medication such as diabetes, kidney impairment, infection and some forms of cancer such as skin cancer and lymphomas (Littlejohn and Routledge 2009). Regular therapeutic drug monitoring through blood tests are needed, particularly in the immediate period following transplantation, to ensure that the doses of the immune-suppression medications are appropriate to the needs of the patient.

The role of the transplant co-ordinator begins on initial referral to the transplant service. The transplant co-ordinator is responsible for the psycho-social and holistic support of the patient throughout the transplantation procedure. This involves care and support of the patient in the pre-transplant assessment phase, the early post-transplant stage and then the long-term follow up and support of this patient group (North American Transplant Coordinators Organisation 2004). It is essential that patients are given all of the information they require to enable them to become active participants in the management of their medical requirements.

A fundamental way in which the transplant co-ordinator and multidisciplinary team can support and provide information is by building honest and open relationships with each patient. Effective communication is essential for patients to have a good understanding of their medications and how to administer their drugs before discharge (Gould and Mitty 2010). The education process is an essential component of the role of the transplant co-ordinator and is best started once the patient is medically stable and able to cooperate (Falvey 1996).

The transplant co-ordinator will usually start this process with the patient and their families and discuss in detail the medications that the individual will be receiving. Healthcare professionals should keep in mind that patients will experience varying degrees of psychological trauma adjusting to being a newly transplanted patient. The patient's ability to understand and retain information will be affected, therefore this must be assessed before education can begin effectively and it may be that

education has to be broken down into smaller daily sessions with all members of the multidisciplinary team continually re-iterating what has been said. Education should, where possible, be offered when other family members can be present as this offers the patient further support on discharge.

The most common immunosuppressive drugs used in liver transplantation are summarised in **Table 2**.

Table 2 Common immunosuppressive drugs in liver transplantation (adapted from Geissler and Schlitt 2009, British National Formulary 2010)

Drug	Most common side effects	Other information
Methylprednisolone	Diabetes, Osteoporosis, obesity	Given for three days following liver transplantation
Prednisolone	Diabetes, Osteoporosis, obesity	Patients with Immune-mediated liver disease may require long-term steroids
Tacrolimus	Renal Toxicity, Diabetes	Doses are assessed on an individual patient basis
Mycophenolate mofetil	Gastro-Intestinal disorders	Low renal toxicity

Tacrolimus is a first-line therapy at many transplant centres in the UK. Tacrolimus comes in two preparations: immediate release Prograf which is administered in two doses 10-12 hours apart, and Advagraf which is longer acting and is administered just once a day, preferably in the morning. Both preparations should be taken on an empty stomach or one hour before or two hours after food (British National Formulary (BNF) 2010).

Generally the vast majority of patients will commence on Prograf, however once graft function is stable it may be appropriate to convert to Advagraf. Advagraf has the advantage of being less restrictive to the patient's daily routine, the patient needs to take fewer capsules, and it makes it easier for them not to miss doses.

It is important that the patient understands the difference between the preparations and brands prescribed. Any changes in preparation or brand should be made under the supervision of a specialist transplant centre as errors can easily occur (Drug Safety Update 2009). Initially the newly discharged patient can expect to be seen in the outpatient clinic weekly for monitoring of immune-suppression levels and graft

function, with appointments becoming less frequent as graft function and drug levels become more consistent.

Non-adherence to the treatment regimen is a problem in some settings after liver transplantation. In particular, it is increasingly reported within the adolescent population (Wainwright and Gould 1997, Berquist *et al* 2008). Patients need to understand that non-adherence with their medication can ultimately lead to acute and chronic graft rejection and graft failure.

Research suggests that transplantation results in improved quality of life overall, but problems with some patients physical and social functioning may persist (Dew *et al* 2008). The nurse's role is to support patients' immediate and long-term recovery with specific interventions to promote quality of life (Littlefield *et al* 1996, Bravata *et al* 1999). The transplant co-ordinator has a key role in the health promotion of the newly transplanted patient. Lifelong immune-suppression also means that patients are at risk of developing diseases such as diabetes, hypertension, osteoporosis and skin lymphomas (Geissler and Schlitt 2009). There is a growing shift towards the long-term management of patients in whom co-morbidities influence survival outcomes (Myers 2010). Health promotion clinics are being developed in specialist transplant centres to identify patients at risk of long-term complications and to promote health and lifestyle choices which aim to influence their survival. Some examples of the advice which may be given are outlined in **Table 3**.

Table 3 Health advice for post-liver transplant patients

Advice	Rationale
Avoid grapefruit juice and Seville oranges (British National Formulary 2010)	Interferes with the metabolism of some immune-suppressant agents
Avoid live vaccinations	Risk of developing an active infection (Sester <i>et al</i> 2008)
Avoid sun-bathing and use high protection sunscreen factor 30+	Increased risk of developing skin carcinomas (Littlejohn and Routledge 2009)
Avoid uncooked meats, fish and unpasteurised dairy products	Increased risk of infection (Paya and Sia 2000)
Contact the GP if there are any changes to health	Long-term health benefits are usually better the earlier patients are treated
Immunosuppressive agents should only be changed or adjusted by an	

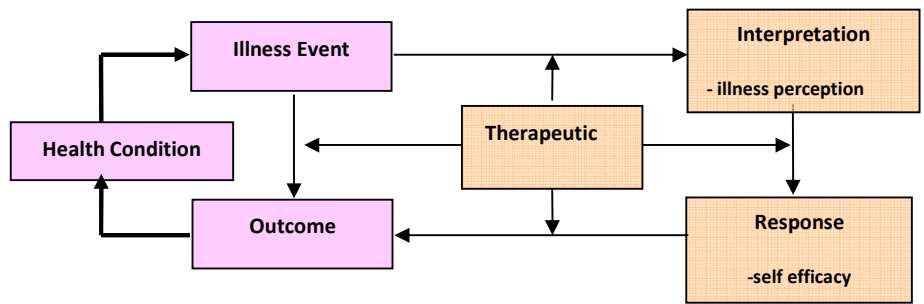
experienced liver clinician (Drug Safety Update 2009)	
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[A HEAD] Factors influencing post-transplant recovery and outcome

Following the procedure transplant patients need to adhere to a complex treatment plan involving self-medication, a specific diet, lifestyle changes and rigorous self-care to achieve optimal outcomes. Research in patient illness beliefs suggests that illness beliefs are a more influential factor for patient recovery than the severity of their illness (Leventhal *et al* 1984, Petrie and Weinman 1997). The implication of this research is that effective patient education needs to encompass a more holistic approach that is tailored to address individual beliefs about the patient’s illness and provide strategies to promote patient confidence to manage their self-care (Mullen *et al* 1992, NICE 2009)

To implement supportive strategies for self-care is complex (Bandura 1997, Lau-Walker and Thompson 2009). Research specifically involving assessing the illness belief and self-care of liver transplant patients is sparse. Generally, the evaluation of self-care involves assessing the choices patients make in response to their illness and their illness symptoms when they occur. The Interactive Care Model (Lau-Walker 2006), seen in Figure 1, aims to promote an individualised care approach by addressing both patient’s illness beliefs (illness perceptions) and their confidence in self-care (self-efficacy). This model draws attention to the need for therapeutic interventions that are focused not only on responding to physiological conditions, but to patients’ responses and interpretations to their condition, treatment and outcomes. It illustrates that successful individualised care for patients with long term care needs following a liver transplant, requires the practitioner to interact with the patient in an attempt to understand and respond to patients’ interpretation of the event, and their capacity to recover and to respond to treatment.

Figure 1 Interactive Care Model (Lau-Walker 2006)



Studies demonstrate that patients' illness beliefs are significantly associated with their lifestyle changes and quality of life in the long term (Lau-Walker *et al* 2009). To provide effective long-term support for patients living with a liver transplant, nurses need to understand individual patients' illness beliefs and their confidence in the adherence to the treatment plan and lifestyle changes.

[TIME OUT 4]

Time out 4

Review the Intended learning outcomes at the beginning of this article. Consider if you have achieved these. If not, review the relevant sections again.

[TIME OUT 4]

[A HEAD] Conclusion

The patient for whom liver transplantation is necessary undergoes a rigorous and intensive post-transplant period. The multidisciplinary team need to work closely together to achieve therapeutic levels of immune-suppression medication, monitor graft function and provide clear and focused education to guide the patient through this process. Despite the successful rates of survival for patients following liver transplantation, the long-term monitoring, support and education of these patients is essential to influence outcome and prevent complications. More research into liver transplant patients' illness perception and self-management may provide the evidence base for effective support and to improve quality of life in the long term.

[TIME OUT 5]

Time out 5

Now that you have completed the article you might like to write a practice profile. Guidelines to help you are on page XX.

[TIME OUT 5]

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