



Maintaining the Gift of Life: Achieving Adherence in Adolescent Heart Transplant Recipients

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ABSTRACT

Since the beginning of United Network of Organ Sharing data collection in 1987, a total of 8,333 pediatric patients have received a heart transplant in the United States. Because these patients now have longer graft success with improved care and immunosuppression, many of them are entering adolescence and young adulthood. Primary care pediatric nurse practitioners need to be alert to the prevalence of noncompliance with treatment in heart transplant patients, which continues to be highest in adolescence. Low compliance in adolescence increases morbidity, contributes to decreasing quality of life, and is the leading reason for graft failure and mortality in this age group. This article will review common barriers to treatment adherence in the adolescent heart transplant patient, discuss the role of the primary care pediatric nurse practitioner in preventing noncompliance, and review strategies that the primary care pediatric nurse practitioner can implement to improve compliance in this patient population. *J Pediatr Health Care.* (2017) 31, 546-554.

KEY WORDS

Adherence, adolescent, heart transplant, pediatrics

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BACKGROUND

In 2015, 423 patients in the United States under the age of 18 years received a heart transplant (U.S. Department of Health and Human Services, 2016). In total, since October 1, 1987 (the beginning of United Network of Organ Sharing data collection), 8,333 pediatric patients have received a heart transplant in the United States (U.S. Department of Health and Human Services, 2016). Thus, in the United States, there is the likelihood that a pediatric nurse practitioner may encounter a heart transplant recipient in practice. Because these patients now have longer graft success with improved care and immunosuppression (77.93% survival at 3 years after transplantation and 70.38% survival at 5 years after transplantation [U.S. Department of Health and Human Services, 2016]), many of these patients are entering adolescence and young adulthood. During this delicate time between childhood and adulthood, these patients have to make the challenging transition to self-care. Noncompliance with treatment continues to be highest in adolescent heart transplant recipients and is the leading reason for graft failure and mortality in this age group (Dharnidharka, Lamb, Zheng, Schechtman, & Meier-Kriesche, 2015; Dobbels, Van Damme-Lombaert, Vanhaeke, & De Geest, 2005; Shellmer, Dabbs, & Dew, 2011).

In the United States, there is the likelihood that a pediatric nurse practitioner may encounter a heart transplant recipient in practice.

This article will serve to aid the primary care pediatric nurse practitioner (PNP-PC) in encouraging compliance in adolescent heart transplant patients and facilitating the transition to self-care and self-management

by discussing the barriers to compliance and management strategies and by providing resources to improve outcomes.

PREVALENCE

Currently in the United States, there are 331 patients under 18 years of age who are listed as waiting for a heart transplant. Additionally, the survival rate under the age of 18 years according to the [U.S. Department of Health and Human Services Organ Procurement and Transplantation Network \(2016\)](#) is 86.35%, 77.93%, and 70.38% at 1, 3 and 5 years, respectively. There are varying reports on the prevalence of adolescent nonadherence. [Loiselle et al. \(2015\)](#) found that roughly 43% of teenage transplant recipients are noncompliant to their medication regimen, and [Meaux et al. \(2014\)](#) reported nonadherence rates for adolescents as high as 65%. Although health consequences of nonadherence in all solid organ transplant recipients are significant, patients with cardiac transplants are especially vulnerable to a catastrophic event due to rejection ([Oliva et al., 2013](#)). [Oliva et al. \(2013\)](#) studied Organ Procurement Transplant Network data from 1999 through 2007; they identified 2,070 pediatric heart transplant recipients and the evaluated the impact of medication noncompliance on survival in these patients. Oliva et al. found that nonadherence in this population was highest (18.3%) among adolescents and that among patients with more than two reported incidences of nonadherence and subsequent rejection, there was a 56% mortality rate within 2 years. These findings serve to underline the grave importance of this topic and highlight the overwhelming incidence of poor compliance in this adolescent patient population.

PATHOPHYSIOLOGY

Reason for Transplantation

Understanding why a patient received his or her transplant is an important part of care as a provider.

Cardiomyopathy

Patients receive transplants for diagnoses of both hypertrophic cardiomyopathy and dilated cardiomyopathy, with the most common indication for pediatric heart transplantation overall being dilated cardiomyopathy ([Thrush & Hoffman, 2014](#)). Both long- and short-term outcomes after transplantation for cardiomyopathy patients are impressive, with 1- and 10-year survival rates of 90% to 95% and 60% to 80%, respectively ([Kirklin, 2015](#)).

Congenital heart disease

Congenital heart disease continues to be the most common reason for cardiac transplantation in infants but has decreased as reparative and palliative surgical interventions have evolved ([Dipchand, Kirk, et al., 2013](#); [Kirklin, 2015](#)).

Retransplantation

Retransplantation is considered for patients with allograft failure due to acute rejection less than 6 months after transplantation, severe coronary allograft vasculopathy or moderate to severe systolic or diastolic dysfunction in the absence of rejection if there are no contraindications to retransplantation present such as a history of significant nonadherence ([Costanzo et al., 2010](#)). Repeat transplantation is rare and is associated with a worse outcome than primary transplantation ([Thrush & Hoffman, 2014](#)).

Graft Failure

There are multimodal ways in which rejection can damage the heart and affect morbidity and mortality. Cellular rejection is mediated by T lymphocytes that are mounted against the allograft tissue in the recipient and found in the cardiac muscle upon endomyocardial biopsy ([Costello, Mohanakumar, & Nath, 2013](#)). Antibody-mediated rejection is facilitated by B lymphocytes, which produce antibodies against the allograft called donor-specific antibodies, and typically occurs soon after transplantation but can occur later ([Pajaro et al., 2011](#)). Coronary allograft vasculopathy is a type of chronic rejection and refers to progressive, occlusive narrowing of the coronary arteries ([Pajaro et al., 2011](#)). This process generally occurs years after transplantation and is the current limiting factor in long-term graft survival ([Costello et al., 2013](#); [Dipchand, Kirk, et al., 2013](#)). PNP-PCs must remember to always assess for the signs of cardiac failure (fluid retention, fatigue on exertion, chest pain) in patients, especially if they are nonadherent, because although most early rejection is asymptomatic, these patients can show signs of early hemodynamic compromise ([Kirk et al., 2014](#)).

WHAT IS NONADHERENCE?

For the purpose of this article, the terms *nonadherence* and *noncompliance* will be used interchangeably. Different organizations have differing definitions of adherence/compliance with medical treatment, which are open to interpretation by reporting centers and thus may affect the reported rates of nonadherence ([Kirk, 2013](#)). The [World Health Organization \(2003\)](#) defines adherence as the “degree to which the person’s behavior corresponds with the agreed recommendations from the healthcare provider” (p. 3), which encourages inclusion of all aspects of nonadherence including medication noncompliance, missed appointments, missed blood draws, procedures, lifestyle modifications, and diet. This definition is important in the sense that all types of nonadherence can affect the health of the patient and the success of his or her graft, not solely medication adherence.

Nonadherence to or noncompliance with medical recommendations in the pediatric heart transplant recipient can encompass many aspects. The most common form of nonadherence in the adolescent patient

population is medication nonadherence (Kirk, 2013). Nonadherence to medication is typically measured by timed medication trough levels, which are drawn either during an appointment or at an outside laboratory facility (Devine et al., 2011).

However, these patients may also be nonadherent to appointments, procedures, routine laboratory work, lifestyle modifications, and diet, all of which have negative repercussions on health and the success of the graft (Shellmer et al., 2011). Ultimately, the definitions available are vague and open to interpretation, and a consistent definition of adherence to medical recommendations is needed (Kirk, 2013).

BARRIERS TO ADHERENCE IN ADOLESCENTS

There are numerous barriers that affect the adolescent heart transplant recipient's adherence with his/her medications and medical regimen. Understanding these obstacles will help the PNP-PC aid the teen in overcoming those barriers.

Socioeconomic Status

Lower socioeconomic status (SES) has been linked to poorer outcomes both for those on the waiting list for a transplant and after transplantation in the pediatric population (Davies et al., 2013). There has long been a correlation between lower SES status and poorer health outcomes reasons including medication cost, access to health care, living situation, cost of transportation to appointments, and low health literacy. Children of lower SES have a greater risk of graft loss after the first year (Singh et al., 2010), and lower SES is associated with worse outcomes late after transplantation (Davies et al., 2013). Inability to obtain or pay for medications, inability to pay for parking at follow-up visits, lack of transportation, or a lack of a stable home will all add to the likelihood of nonadherence to medications and treatment regimens. Social work and case management should be involved in all transplantation patients; however, it is clear that additional attention needs to be paid to those with low SES status because of the increased risk of graft compromise.

Family Environment and Support

Having a supportive and functioning family environment is key to the success of the adolescent transplant recipient. Impaired family function and compromised child psychological function have been associated with higher rates of nonadherence (Shellmer et al., 2011). Adherence and care of the transplanted organ must be seen as a family issue, and attention to the family function, dynamics, and relationships is paramount (Shellmer et al., 2011). Family discord can lead to psychosocial problems in these teens, which, for these patients, can spiral into nonadherence. The PNP-PC can help adherence in these patients by encouraging poorly functioning families to seek out counseling.

Risk-Seeking Behaviors

Adolescence is a time of rebellion, confusion, ambiguity, and risk-taking behaviors for any teenager, let alone one with a complex medical condition. Puberty and hormones have been hypothesized to be responsible for the increase in risk seeking behaviors; however, Smith, Chein, and Steinberg (2013) suggest that asynchrony in the maturation of the brain structures and function may be linked to the influences of puberty on development and risk taking.

Medication nonadherence can be a different challenge in adolescents who have a history of complex congenital heart disease, especially those who have been restricted and hospitalized frequently throughout their lives and now feel a newfound sense of freedom (Kirklin, 2015). Feeling full of energy and healthy for the first time can enhance the feeling of invincibility that is pervasive throughout adolescence, encouraging risk-taking behaviors such as drugs, alcohol, and nonadherence to medications or follow-up visits. Adolescents struggle with the realization that they traded a life-threatening illness for a chronic condition instead of the desired pristine health. These patients now feel physically better yet continue to require daily medications and regular doctor appointments and are now immunosuppressed (Stuber, 2011).

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Adolescents continue to have inferior long-term outcomes from heart transplantation compared with younger recipients, which is believed to be partly related to nonadherence to medications (Dharnidharka et al., 2015). Risk-seeking behaviors in this age group are not simply manifestations of teen angst but dangerous, graft-threatening behaviors.

Body Image Struggles

Adolescence is a time when teenagers seek to accept their changing body image and struggle with burgeoning sexuality. For the adolescent organ transplant recipient, the physiologic manifestations of his or her immunosuppressive medications are of vital importance. Hirsutism, gingival hyperplasia, weight gain, and short stature are all adverse effects of the post-transplantation immunosuppressive regimen and can cause adolescents to become nonadherent with medications (Griffin & Elkin, 2001; Lawrence, Stille, Olshansky, Bender, & Webber, 2008). Teens may either not understand the risk of being nonadherent with their medications or, at the time, may weigh their physical appearances as being more important

than medication adherence. The feeling of looking different is in direct conflict with the adolescent desire for normalcy and fitting in with their peers (Stuber, 2011).

Additionally, antihypertensive medications, which are often used in heart transplant recipients, may cause sexual adverse effects (namely, impotence), and these can be perceived as devastating to the male adolescent (Stuber, 2011).

Being open to discussing the issues with patients and working to ameliorate their concerns regarding their appearances or sexual functions will help adolescents feel a sense of control over changing that which is concerning to them. Hair removal techniques, approved acne medications, exercise suggestions, and referrals to a psychologist are ways in which the primary care provider can provide aid to teenage patients (Dobbels et al., 2005).

Maturity and Brain Maturation

Adolescent brains are not the same as adult brains because they are not yet entirely mature. The prefrontal cortex does not fully mature until the age of 25 years (Stuber, 2011). Adolescents are notably prone to nonadherence with medical prescriptions and medical advice, which is due in part to the developmentally appropriate questioning of authority and need to make their own decisions (Stuber, 2011). *Executive functioning* is a neuropsychological term that includes many of the more advanced cognitive skills such as organization, planning, and problem solving (Gutierrez-Colina et al., 2015). Gutierrez-Colina et al. (2015) showed that adolescents and young adult solid organ transplant recipients have significantly greater levels of dysfunction in total executive functioning and metacognitive abilities compared with the normal reference scores of healthy peers. Caring for themselves as young adults will require organization and planning skills to maintain their complex medical regimens, and thus, deficits in overall executive functioning can introduce significant challenges (Gutierrez-Colina et al., 2015). The PNP-PC may consider neurocognitive testing if the deficits in executive functioning are becoming a barrier to the patient's adherence.

Transitioning to Adulthood and Independence

A common theme that has emerged is the understanding that the teens can and need to take responsibility for medication regimens. However, this shift to self-care can be a stressor in the parent-adolescent relationship as parents struggle with trusting their adolescents to manage their medications autonomously (Adams, Evangeli, Lunnon-Wood & Burch, 2014). Parents must be counseled at the start of preadolescence to begin to allow teens to take more ownership of their medications and medical management. Family therapy or

counseling can help smooth this transition and enhance family function.

Confusion can arise surrounding who is now responsible for medication adherence between the adolescent and parent (Shellmer et al., 2011). A slow, gradual change from parent-directed medical management to adolescent self-management is ideal yet can be fraught with difficulties. This evolution of care can be intimidating and frightening to both parents and adolescents. However, a child who is given or who takes on none of the responsibility for his or her care until adolescence is more likely to see the regimen as something imposed by adults and is far more likely to resist, rebel, or become nonadherent (Stuber, 2011).

Meaux et al. (2014) showed that teens who readily accepted ownership (and the parents who permitted them to do so) and incorporated their medication regimen into daily life were more successful. Starting the transition to self-care must begin in early adolescence; however, if the patient is pushed into fully caring for himself/herself before the brain is mature with well-developed executive functioning, he or she could be set up for failure. A delicate balance is needed with extensive support for both the teen and his/her family throughout this time.

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IMPROVING ADHERENCE

Nonadherence is a problem for documented adolescent heart transplant recipients (Dharnidharka et al., 2015; Dobbels et al., 2005; Shellmer et al., 2011). However, there are strategies that PNP-PCs can implement to improve adherence in this patient population.

Support Groups

Being around peers their own ages who are dealing with the same issues can help these teens feel less isolated and more normal. Korus, Cruchley, Stinson, Gold, and Anthony (2015) found that teenagers wanted more occasions to network socially with other adolescents who had gone through transplantation in their usability testing of the first three modules of their Internet program "Teens Taking Charge: Managing My Transplant Online." All 21 adolescent transplantation patients who participated in this testing enjoyed the videos of other patients discussing their experiences (Korus et al., 2015). Online or in-person support groups conducted specifically for adolescents who have undergone transplantation should be coordinated by all

transplantation centers to provide a built-in support network for these patients. PNP-PCs should encourage patients and families to participate in such opportunities and aid them in seeking programs out when needed.

Smart Phone Use

With the increasing popularity of smartphones, it is not surprising that 75% of teens use text messaging, with most older adolescents sending more than 100 text messages a day (Lefkowitz & Fitzgerald, 2016). Because of the popularity of smart phones among the adolescent population, applications that send text reminders to take medications at a specified time are gaining popularity (Lefkowitz & Fitzgerald, 2016).

Text message reminder systems and mobile health applications have been shown to improve medication compliance among adolescents who have undergone solid organ transplantation (McKenzie et al., 2015; Shellmer, Dew, Mazariegos, & DeVito Dabbs, 2016). For a more comprehensive list of apps, programs, and Web sites to help adolescents and their parents manage complex medical problems in the age of technology, see Tables 1 and 2.

Additionally, Meaux et al. (2014) found that teens preferred the anonymity of online communication to face-to-face support groups. The PNP-PC should assess the preferred method of communication and note that some teens may prefer e-mail, online chat rooms, or online education.

Group Visits

Seeing multiple patients with the same chronic disease condition at the same time in a group setting (with separate private physical examinations) is a method that has recently been investigated in this specific patient population. Group visits can be conducted monthly, bimonthly, or biannually depending on the needs of the specific group of patients. As an example, each visit could begin with individual laboratory work and physical examinations and then be

followed by a 1-hour group session led by a nurse practitioner or physician for a period of open discussion or education. Although previous studies had shown that the group visit method can successfully be applied to primary care pediatrics and a plethora of other chronic disease conditions, to our knowledge, no studies have been done on the pediatric heart transplantation population (Dodds, Nicholson, Muse, & Osborn, 1993; Quinones et al., 2014). Hollander et al. (2015) recently showed that this method can effectively be applied to the pediatric heart transplantation population with a high level of patient and family satisfaction, increased face time with providers, and exceptional retention of the content discussed.

Improved Care Transition

Care transition in this patient population can refer to two different transitions; the transition to an adult health care provider and the transition to self-management.

Transitioning from a pediatric provider to an adult provider

This transition is difficult and is a period that can exacerbate or trigger nonadherence. Pediatric patients become comfortable with their providers as a safety net and may have been followed by their transplant team and PNP-PC since diagnosis (which may have been in infancy). McManus et al. (2015) showed that having an organized clinical process and transition readiness assessments throughout late adolescence helped set the patients up for success. Although this transition is inevitable and necessary, it must be done slowly and gradually to ensure that a patient feels comfortable with his or her new medical team. When a patient is closely followed during this transition and guided through this change, the transition is more likely to be smooth and controlled, with minimal to no nonadherence (Annunziato et al., 2013).

TABLE 1. Medication reminder smartphone applications

App name	Compatible	Cost	Location
My Med Schedule	Android, iOS 7.0 or later	Free	Google Play Store, Apple App Store
MediSafe Meds and Pill Reminder	Android, iOS 8.0 or later	Free	Google Play Store, Apple App Store
Medi-Prompt	iOS 6.0 or later	\$3.99	Apple App Store
Pill Reminder—All in One	iOS 6.0 or later	Free	Apple App Store
My Pillbox	Android	Free	Google Play Store
MedCoach	iOS 6.0 or later	Free	Apple App Store
Transplant Hero	iOS 8.0 or later	Free	Apple App Store
Easy Pill	iOS 7.0 or later	\$2.99	Apple App Store

Note. iOS, Apple (Cupertino, CA) operating system.
Applications created directly for teens with transplants (i.e., Teen Pocket PATH) are not yet available (Shellmer, Dew, Mazariegos, & DeVito Dabbs, 2016).

TABLE 2. Web resources for patients and families

Resource	Purpose	Location
MyHealth Passport	Patient can create a customized card that gives him/her instant access to medical information.	https://www.sickkids.ca/myhealthpassport/ Hospital for Sick Children
World Transplant Federation Games	Biannual, multisport, international sporting event for transplant athletes	http://www.wtgf.org
UNOS—What every kid needs to know	School-age book about transplants to begin education and interest in children.	https://www.unos.org/wp-content/uploads/unos/WEKNTK.pdf
<i>Organ Transplants: A Survival Guide for the Entire Family (It Happened to Me)</i> by Tina P. Schwartz	A book with real-life stories of teens whose parents, siblings, or other family members are transplant recipients, as well as teens who have received transplants themselves.	http://www.amazon.com/Organ-Transplants-Survival-Entire-Happened/dp/0810849240?ie=UTF8&s=books&qid=1187802741&sr=1-1
Children's Organ Transplant Association	An organization that provides aid and support to children and young adults who need a transplant	www.cota.org

Transition to self-management

Adolescents must begin to learn to be the primary manager of their complex medical regimen. The transition to self-management is an active, daily, oscillating process in which teens begin to assume control over their health and well-being, including chronic disease management (Meaux et al., 2014). Maturity and independence must be encouraged early in adolescence in age-appropriate terms (Lawrence et al., 2008). Pre-teens and adolescents can be encouraged to take ownership of their transplant by carrying a personalized informational wallet card containing information about their transplant (refer to Figure 1). Adolescent patients' level of executive functioning (planning and organization) may be impaired (Gutierrez-Colina et al., 2015). The processes governed by executive function are not limited to taking medications, but also entail timing of refills, communication with insurance companies, scheduling of surveillance biopsies, and maintaining prescribed laboratory schedules. An adolescent patient should be monitored during transition at first and have multiple resources to contact if he or she has questions.

ROLE OF THE PNP-PC

Primary care providers must not only understand why adherence problems exist in this patient population but must play a significant role in improving compliance in these adolescents as the established medical provider and longstanding care coordinator. The PNP-PC must address all aspects of non-adherence in order to be comprehensive in their care of these patients (see Figure 2).

Clinical

Care coordination and follow-ups

Maintaining an open line of communication with a patient's transplantation team and other members of the

care team is key to helping a patient and family manage what is typically a plethora of appointments, follow-ups, and laboratory draws. Making sure to set aside time with a family at every annual visit to discuss and lay out a patient's follow-up schedule with all of their specialists is a way the PNP-PC can minimize confusion, stress, and ultimately nonadherence. Helping organize a schedule of appointments, offering support, and identifying any potential barriers to compliance is part of creating a medical home and aiding in care coordination.

Maturity and developmental assessments

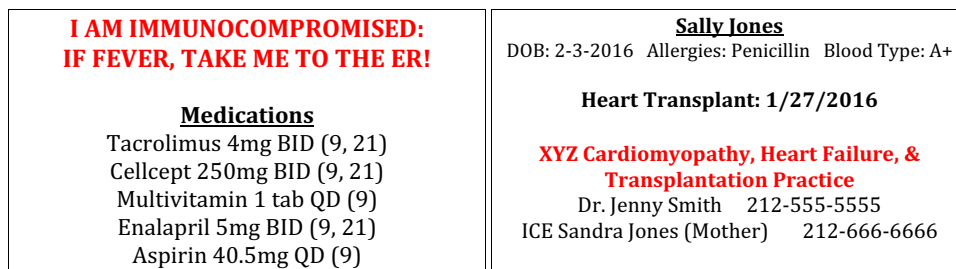
Lawrence et al. (2008) supported the idea that developmental maturity was directly related to adherence among adolescent and young adult heart transplant recipients. Overall, there was a sharp dichotomy between the good adherers and the poor adherers along the themes of developmental age and relationships (Lawrence et al., 2008). Maturity is an ongoing process that must be continually reassessed, and the education of a specific patient must be tailored appropriately.

PNP-PCs can aid families by performing developmental and maturity assessments not only to help guide the transition to self-management but to identify those patients at risk for nonadherence during the transition because of their developmental status. Health care providers can gain valuable information about their adolescent and young adult patients' neurocognitive functions and developmental statuses by assessing executive functioning. This can direct the guidance given to families and patients about transitioning adolescents to self-care and the appropriate levels of responsibility these patients should be able to assume.

Screening for depression and substance abuse

Depression in adolescent cardiac transplantation patients is a real concern. A chronic illness can

FIGURE 1. Sample of a wallet card teens can personalize.



This figure appears in color online at www.jpedhc.org.

lead to anger, sadness, and frustration, all of which can have negative effects on medication adherence (Dobbels et al., 2005). Depression, anxiety and posttraumatic stress disorder need to be addressed appropriately to prevent adherence problems (Dobbels et al., 2005; Supelana et al., 2016). The PNP-PC should be screening for depression with recommended screening tools at least once a year according to the American Academy of Pediatrics (2016) if not at every visit. Early identification and appropriate mental health referrals and care are key in preventing depression-related nonadherence in this population.

Implementing group visits

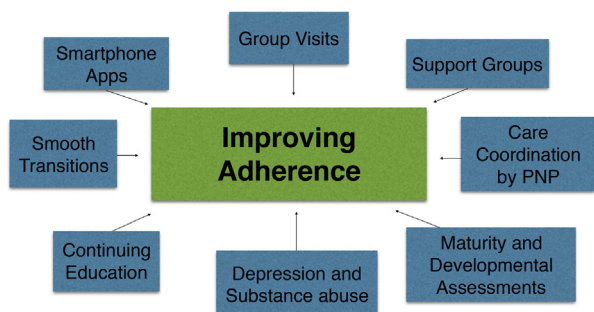
The group visit method can be suggested to the patient's transplantation office. Additionally, if the PNP-PC has more than one adolescent transplant patient in his or her practice, this method could be used for primary care visits.

Education of the Patient and Family

Before transplantation

Transplant education, including the importance of adherence, must begin before transplantation, during

FIGURE 2. Facets of adolescent adherence.



This figure illustrates the multitude of components that should be considered in the primary care of the adolescent transplant patient. This figure appears in color online at www.jpedhc.org.

the listing process. Understandable and comprehensive educational material should be provided to the family and patient during the listing process. Special care should be taken to ensure that both family and patient (if age appropriate) understand the lifelong commitment that is required after receiving an organ transplant. Transplantation centers may have their own educational information, and many centers in the United States and Canada use a comprehensive educational booklet from the Pediatric Heart Transplant Study (Dipchand, Bastardi, & Dupuis, 2013). Primary care providers should discuss the commitment and evaluate the level of understanding of a patient and his or her family, if possible, before a transplantation occurs.

After transplantation

Immediately after transplantation is a time for healing. However, it is important at this stage that the transplantation team have significant continued education for the patient and family on the medications and follow-up processes before discharge from the hospital. Seeing a patient for the first primary care appointment after transplantation is the optimal time to have a detailed discussions about the medication, follow-up schedule, lifestyle recommendations, etc.

Continuing and age appropriate

Typically, much of the effort for education is focused on the pretransplantation and immediate posttransplantation period (Lawrence, Stille, Pollock, Webber, & Quivers, 2011). However, continued age-appropriate education as the patient grows and matures should take place before the outside stressor of the adolescent needing to transition to self-care and adult providers (Lawrence et al., 2011). A family-centered educational program, consisting of videos and written material to be reviewed as a family at home, can significantly increase the knowledge level (Lawrence et al., 2011). A mature understanding of the purpose of their transplant, why medication adherence and timing is imperative, and how to meld their medical needs into their lives is key in lowering the level of nonadherence in teen heart transplant recipients.

Research

Much of the research performed in this area focuses on kidney or liver transplant recipients. More research is needed on nonadherence in heart transplant recipients specifically (Kirk, 2013; Shellmer et al., 2011). Additionally, there is a scarcity of research on interventions to increase adherence in this age group, which is where research should be directed on this topic (Kirk, 2013). Cell phone applications and use of smartphones in helping to aid compliance in this specific population needs continued development and research into their ease of usability and effectiveness in reducing nonadherence.

CONCLUSION

Noncompliance in teenage heart transplant recipients continues to be the leading reason for graft failure in this age group; adolescent nonadherence outpaces that of any other age group (Dharnidharka et al., 2015; Dobbels et al., 2005; Shellmer et al., 2011). By incorporating patient education, screening tools and group visits and by providing age-appropriate resources for our patients, PNP-PCs can use this knowledge to help reduce the hurdles adolescents encounter in living with this chronic condition. An individualized approach to each patient, taking into consideration their maturity level, need for education and executive functioning, as well as their likelihood to respond positively to mobile health initiatives or support groups, can easily be implemented into the practice setting. This multifaceted approach can enhance the practitioner's ability to engage patients and work collaboratively toward the goal of adolescent adherence and overall improved quality of life.

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