Role Development of Nurse Practitioners and Physician Assistants in Liver Transplantation

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Abstract

**Background:** Nurse practitioners (NPs) and physician assistants (PAs) are increasingly utilized in health care. However, their roles in liver transplantation (LT) have not been investigated. **Materials and Methods:** In this study, we reviewed the employment and development of NPs and PAs and their impact on our deceased-donor LT (DDLT) program. **Results:** We found a safe and efficient way to utilize NPs and PAs in a DDLT program. Since the beginning of our program, Model of End-Stage Liver Disease (MELD) scores have increased significantly, suggesting patients are sicker at the time of transplant, and wait times of patients have become longer. With the incorporation of NPs and PAs, we found that length of stay (LOS) was not affected. The overall median warm ischemic time did not increase. Outcomes of LT for both patient and graft survival actually improved and remain at or above the expected values. These results collectively support the usefulness and validity of NPs and PAs in a DDLT program. **Conclusion:** We have determined that surgical and medical NPs and PAs are essential for optimal patient outcomes. They facilitate a better learning experience for residents and fellows on their transplant rotations. Further investigations to assess the roles of these providers and their impact on the education of residents and fellows in transplantation are warranted. Further transplant hepatology education programs and/or fellowships are recommended to assist in the education and professional development of transplant NPs and PAs.

Keywords

nurse practitioners, physician assistants, liver transplantation, role development

Introduction

Utilization of nurse practitioners (NPs) and physician assistants (PAs) is drastically increasing in the United States. With the mandated change in residency work hours, a significant physician shortage, and change in health policy with the Affordable Healthcare Act, there is and will continue to be a health-care provider shortage. Many organizations are discovering that NPs and PAs can successfully fill this gap by providing safe and effective patient care while reducing hospital length of stay (LOS) and improving job satisfaction of physician and resident colleagues. Traditionally, NPs and PAs care for patients with chronic diseases, however there is a trend toward a higher percentage now seeking employment in the medical and surgical subspecialties rather than primary care. Several publications have reported the successful and safe use of NPs and PAs in a variety of health-care settings, but the role of these providers in liver transplantation (LT) remains undefined. The goal of this article is to show the evolving role development of NP/PAs in the hospital and surgical services of a deceased-donor LT (DDLT) program, as we moved away from a service model utilizing only physicians and fellows. In this article, we demonstrate that the incorporation of NPs and PAs into the medical and surgical care of patients undergoing LT has not negatively impacted patient LOS or other measures of patient care. We will also discuss lessons learned and key information which we believe has been important for developing a successful program.

Methods

We retrospectively reviewed our outcomes of patients transplanted from the inception of our program, February 23, 1998, to March 15, 2014. During that time, 2656 patients underwent LT. Much of the data was prospectively collected. The study was approved by Mayo Clinic Institutional Review Board.
The donor variables obtained include age, gender, body mass index (BMI), donation after brain death, donation after cardiac death, blood type, donor warm ischemic time (WIT), and cause of death. The donor risk index (DRI) was computed as described previously in the literature. The recipient variables included age, gender, BMI, primary and secondary diagnoses, physiologic and exceptional Model for End-Stage Liver Disease (MELD) scores, time and date of transplantation, number of prior LT, date of death, date of graft loss, cause of graft loss, need of intensive care unit post-LT, and LOS in the hospital after LT. The operative parameters collected include duration of operation from skin incision to the wound closure, cold ischemic time, WIT, transfused packed red blood cells, primary surgeon, assisting surgeon, fellow, resident, NP, or PA.

As shown in Figure 1, the study period was divided into 3 eras: Era 1 (1998-2004) is associated with the utilization of only surgical technicians in the operating room, and the inpatient care was provided by staff physicians and fellows; era 2 (2005-2010) incorporated NP/PA providers into our DDLT program; and era 3 (2011-present) separated the role of the NP/PA providers to medical and surgical services.

 Médian, mean, and standard deviation for MELD, DRI, WIT, LOS, and wait time were calculated. Of note, N values in era 1 varied with MELD reporting, since MELD system did not exist prior to February 2002; thus, MELD was computed in 776 cases. Of the 840 cases completed in era 1, DRI was calculated in 830 cases and WIT in 835 cases due to missing data. In eras 2 and 3, only 1 missing data occurred in each computation of DRI. P values are demonstrated for each examined characteristic with statistical significance demonstrated in all values except LOS. By assessing the medical variables including MELD, DRI, LOS, and wait time, and a specific surgical metric of warm ischemic time, that is, WIT, we evaluated the evolving role of medical and surgical NPs/PAs in DDLT at our center. Although the clinical MELD score showed increasing medical severity and higher demand in increasing wait time, the clinical management was not affected as the length of stay after DDLT. Moreover, there appeared no change in WIT which is associated with the critical time when the transplanted liver being sewn in and a surrogate marker for the technical efficiency of the attending surgeon and his or her first assistant.

Results

Era 1: Recognition of Need for NPs and PAs in a Growing LT Program

From the beginning in 1998, the LT program at our center has grown with initially 54 transplants performed our first year to as many as 245 transplants completed yearly in 2004 and 2005 (Figure 2). Since 2007 to present, the number...
of LTs has averaged about 150 to 160 per year, making it one of the largest LT programs in the country. Through the development of our program, we have formed a collaborative team approach to patient care. Our transplant hepatologists evolved, taking on primary roles in medical management during both pre- and post-LT periods. The transplant critical care service has been a core constituent of our practice. At each LT, a dedicated transplant anesthesiologist works closely with the operating transplant surgeon. We have had support from other surgical and medical subspecialties during all phases of LT including transplant infectious diseases, hematology and blood bank, nephrology, pulmonary, cardiology, cardiothoracic surgery, neurology, neurosurgery, and others.

From 1998 to 2004, surgical technicians provided the operating assistance, particularly as first assistants during LT since we had limited residents and fellows (Figure 1). In addition to LT, the transplant surgeons also performed the donor procurements and were responsible for kidney and pancreas transplants at our institution. With the growing volumes of transplant activity, we soon recognized the need for and the important role of NPs and PAs in our practice.

**Era 2: Implementation and Role Development of NPs and PAs in DDLT**

Due to changes in practice, the role of NPs and PAs evolved. In 2004, the volume of LT increased dramatically. We discovered that the utilization of NPs and PAs was a reasonable solution to the workload demands of our busy practice. Our patients needed more consistent timely care from the medical team that could not be provided at current staff levels. The NP/PA providers could also bill for their services. We started with 2 PAs assisting the medical LT hospital service and increased to as many as 8 NPs/PAs as illustrated in Figure 1. To meet the patient and surgical demands of the increased number of surgeries, we incorporated the NPs and PAs as surgical assistants.

Our practice developed the NP and PA role to cross cover both days and nights on the medical and the surgical service. The same group of NPs and PAs split their time into surgical and medical rotations. Half of their time was spent on the transplant hepatology service in the hospital managing the medical care of all LT patients, including pretransplant patients admitted for liver disease complications, transplant admission, and post-LT readmissions. The other half of their time was spent with transplant surgery, including hospital rounds with the attending transplant surgeon and assisting in the LT operation and other surgical procedures, including hernia repairs and other abdominal organ transplants. These providers were required to first assist in the operating room and cover the patients admitted to the hospital under the transplant surgical service. This dual role of perioperative responsibility and first call admission proved to be very demanding for the NP and PA staff, causing a great deal of employee turnover. Dissatisfaction was verbalized from NP and PA individuals, and concerns were raised regarding patient continuity of care as well as efficiency and surgeon satisfaction in the operating room.

**Era 3: NPs and PAs Improved Clinical Growth Without Negative Effects on Surgical and Medical Practices of DDLT**

From 2009 to 2012, we performed approximately 165 LTs each year, and the same group of transplant surgeons also performed 94, 110, 129, and 158 kidney transplants and 7, 10, 11, and 5 pancreas transplants each year, respectively. In 2009, the decision was made to split the services into separate medical and surgical teams (Figure 1). All of the existing NPs and PAs became a medical LT team with collaboration from transplant hepatologists, with the transplant surgical fellows and residents assisting on most of the LT procedures. Realizing that providers with surgical expertise improved surgeon satisfaction in surgical cases, we hired additional PAs with surgical experience in 2011.

Currently, we have 3 surgical PAs supporting all abdominal transplants and related procedures, and 7 medical NPs and PAs supporting the medical team of LT. The current model provides a more reasonable workload and allows for NPs and PAs to become efficient and more competent in their respective areas. Following this transition, many NPs and PAs reported a better working environment, an improvement in work schedule, greater quality of life, and increased work–life balance. With our current practice, the informal discussion with nursing staff has reported better accessibility to provide timely patient care,
and we have implemented a better procedure to capture billing and reimbursement of services.

**Crunching the Numbers**

To quantify our results, we used LOS to determine the impact NPs and PAs had on the LT hospital practice throughout the growth of our program. For each era (1-3), N indicates the number of primary DDLT performed excluding retransplants, multiorgan transplants, and additional procedures performed at the time of LT such as pancreaticoduodenectomy. We considered 2224 primary LT cases ($n = 840, 948, \text{ and } 436$, respectively). The LOS was computed for patients who were admitted for LT until the day they were discharged. As shown in Figure 1, MELD scores increased significantly, the wait times of the patients on the wait-list got longer, and the DRI decreased as the donor selection became more defined. List wait time increased as a result of donor availability and other factors not related to staffing, even though we have a demanding practice. This indirect variable affects our practice and clinical complexity of the patients. This was reflected in a national trend toward increased MELD scores at the time of LT and longer waiting times. The median LOS remained at 7 days, despite an increase in clinically more complicated patients with higher MELD scores. The LOS did not change, and patient care remained effective over the 3 eras. This suggests consistent management and practice by the LT medical and surgical teams with the incorporation of NPs and PAs sustaining the practice model well.

To further assess the effect of NPs and PAs on the surgical LT practice, we specifically analyzed the WIT. The WIT begins when the liver graft is removed from ice-cold preservation, and the suprahepatic cava venous anastomosis is started the moment the liver is reperfused with the recipient portal blood. The WIT was selected as a measure to evaluate the LT surgical practice since this time defines a critical window in which the capability of the first assistant in LT is crucial, and prolonged WIT would be detrimental to the liver graft. The same selected cohort was used. We observed that the overall median WIT did not increase as we implemented the use of NPs and PAs. In fact, as shown in Figure 1, WIT decreased, suggesting the use of surgical PAs as first assistants in LT did not negatively affect the transplant surgeon during the operation.

In addition to LOS and WIT, we examined the LT outcomes during the evolution of the program. The patient and graft survivals at 1 year were obtained from the Scientific Registry of Transplant Recipients (http://www.srtr.org/). As shown in Figure 3, graft outcomes improved and patient survivals continued to be at or above the expected values. These results collectively support the role development of NPs and PAs confirming their usefulness and validity in the growth of the DDLT program.

**Discussion**

Our experience with medical and surgical NPs and PAs demonstrates that these providers have the expertise to care for transplant patients throughout the transplant process, including care prior to, during, and after transplant (in the immediate and long-term setting). These providers can first assist in surgery, perform bedside procedures, and direct patient care with physician collaboration. One study by Collins et al evaluated the outcomes of adding NPs to a level 1 trauma service. The NPs where assigned to a trauma step down unit 5 days per week. Results showed that physicians and nurses were very satisfied with this transition, and there was clear benefit shown with a decrease in LOS for these patients, and a 27.8 million dollar reduction in cost over the course of 12 months. Roy et al noted that for general medicine inpatients admitted to an academic medical center, a service staffed by hospitalists and PAs can provide a safe alternative to house staff services, with comparable efficiency and lower cost of care. Pezzi et al found that using NPs and PAs was cost effective and a valuable option in assisting with the increased work demands caused by the decreased resident work hours. Robles et al noted that the addition of an NP to the surgical practice resulted in an increase in patient-to-provider telephone communication, an increase in nurse and rehabilitation consultations, and a 50% reduction in the amount of unnecessary ER visits. Perry et al surveyed the chairman of departments of general surgery in 552 hospitals with more than 400 hospital beds about the current and
projected use of surgical PAs. Two-thirds of the chairmen felt PAs had improved surgical patient care in their institutions, and almost half felt that surgical PAs had improved the quality of residency training.16

At our center, we realize that there are differences between the NP and the PA provider, however, we have found a model where we can successfully utilize both to provide effective patient care. The NPs’ education and training is from a nursing model, while PAs are trained on a medical model alongside medical students and physician residents. Most NPs have several years of nursing experience prior to becoming NPs. The majority of PA schools require students to have extensive patient contact hours with a PA prior to program admission. Both NPs and PAs are master’s prepared when entering into their roles and will be found in most any medical field.

The training of both NPs and PAs focuses on general medicine. There are only a small number of fellowship training programs in subspecialty practice. One must thus advocate for continued development of specialized education and training programs for the NP and PA. The literature suggests that postgraduate residency programs are needed to further train NPs and PAs for specialized fields, such as transplant.17,18 Little of the training in an NP or PA program prepares that provider for the actual day-to-day life of a transplant NP or PA.18 Postgraduate programs are encouraged by the American Academy of Physician Assistants, and their organization has instituted a program specialized in placing qualified new graduates with additional training opportunities.18 The American Association for the Study of Liver Diseases provides a postgraduate fellowship that offers NPs and PAs the opportunity for additional training in the field of hepatology.19 Such programs are encouraged, as many new NP and PA graduates are unaware of a rewarding career in hepatology and transplantation. Multiple centers have instituted hospitalist NP/PA programs to create a structured learning environment to prepare newly hired NP and PAs for hospital-based medical practice. They cover essential topics and learning tools that will be needed for the new NP/PA. A Certified Medical Education (CME) course was created to review hospital medicine, including areas of administration, infectious disease, palliative care, and a procedure learning laboratory. A preceptorship program was created, and a grand rounds monthly lecture series was instituted. By providing this educational support, NP/PAs are given a great opportunity to succeed.20 At our center, we continue to emphasize ongoing continuing education and professional development for all staff, particularly the NP and PA providers.

As of December 2, 2014, there have been 2798 LTs performed at our center since its opening in 1998. These patients can have complications of their liver disease at any time, and the ability to triage and guide patient care is essential. From our experience, there are certain characteristics of the medical NP/PA and surgical NP/PA individuals that contribute to program success. Medical NP/PAs work directly with transplant hepatologists and surgeons to properly plan for patient care. They are proficient and efficient in their roles, sustaining a constant flow of medical care in a busy service. The surgical NP/PAs have been specifically trained to master the flow and sequence of the LT procedure. They are relied on to communicate with the medical team about the events of surgery, act as liaisons between the transplant surgeons and hepatologists for patient management, and provide assistance with surgical issues on the hospital floor.

In recent years, surgical and medical residencies have faced many challenges, including how to conduct training in the appropriate number of work hours to assure a competence of medical and/or surgical trainings. We believe that the incorporation of NPs and PAs into our practice can be very beneficial to the residents and fellows on their transplant surgical rotation. Experienced surgical NPs and PAs provide more educational opportunities and are available to take care of the routine needs of the patients, giving the residents and fellows more time to focus on their learning objectives. Second, in the operating room, we have found that the NP/PA guides the residents and fellows through the case by reminding them of the expected and anticipated next steps of the complex phases of the LT surgery. We found that this one-on-one, minute-to-minute coaching during an ongoing procedure is very helpful to enhance the understanding and confidence of the assisting resident and fellow. This pattern of cooperative coaching is conducive to learning21 and may serve to ameliorate the concerns among the senior residents in training with restricted duty hours.22 Future investigations are warranted to enhance the education of residents and fellows in LT and to delineate specific criterion to define optimal performance.

The metrics to comprehensively analyze the positive and negative influences of NPs and PAs in the complexity of DDLT remain poorly understood. Our study is limited by its retrospective nature. Surrogate markers, including WIT and LOS, in addition to patient and graft survivals, might provide an insight into the contribution and development of NPs and PAs in transplantation, but robust metrics need further investigations. However, with the projected future decrease in practicing physicians, an increase in the number of insured patients seeking medical treatment, further policy changes due to health-care reform, and a reduction in residency work hours, NPs and PAs are a logical solution to provide effective and high-quality care.1-3

**Conclusion**

It is known that NPs and PAs play an essential role in health-care delivery. In the early time of our DDLT program, there was limited knowledge about the role of NPs and PAs in transplantation as a whole. We implemented the utilization of NPs and PAs and modified their roles as dictated by the needs of the patients and the practice of DDLT at our center. We gradually established a regular practice of billing for the NP/PA service which increased revenue of the organization. As a team, we
developed the role of NPs and PAs to fulfill the obligation and responsibility to the residents and fellows completing their transplant surgical rotation. We sought to offer a desirable work–life balance for our NP/PA staff and attempted to change our vision of the program to provide a better work environment without negatively impacting patient care.

Our study has shown that with the collaboration of attending transplant hepatologists and surgeons, NPs and PAs provide cohesive and comprehensive care to pre- and posttransplant patients. Further research is needed to investigate the financial impact of NPs and PAs and how to utilize these professionals in the most cost-efficient manner. Seeking out individuals who have specific strengths and capabilities is helpful to cultivate a cohesive and effective medical/surgical transplant team. The role development of the NP and PA in our DDLT program serves as a foundation for further improvement and enhancement in meeting the future challenges of healthcare delivery in transplantation. We hope that others will learn from our experience and consider NPs and PAs as a valuable asset to their own practice model.

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References


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