

DONOR-RELATED LUNG TRANSPLANT SURGERIES: NURSING PRACTICE IN THE TRANSOPERATIVE PERIOD

Cirurgia de transplante pulmonar intervivos: atuação da enfermagem no período transoperatório

Cirugía de trasplante pulmonar intervivos: actuación de la enfermería en el período transoperatorio

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ABSTRACT: Objective: To report the nursing practice experience during the transoperative care in donor-related lung transplant surgeries. **Method:** Experience report of the practice of a nurse team in donor-related lung transplant surgeries occurred at the Surgical Center in a hospital in Porto Alegre, RS, Brazil. **Results:** Between 1999 and November 2014, 33 donor-related lung transplants were done. The report is presented in four stages: ethical and legal aspects of donor-related transplants; preparation of the Surgical Center; nursing assistance during the intraoperative period; and forwarding of patients to ICU. **Conclusion:** A transplant is a complex procedure, which involves many professionals and requires knowledge, integration, organization, dedication and a real commitment from nurses. The donor-related lung transplant becomes an even bigger challenge since it involves, in addition to the recipient, two healthy donors, resulting in a huge expectation for the surgery and recovery of three patients to be successful.

Keywords: Lung transplant. Living donors. Tissue and organ procurement. Nursing care.

RESUMO: Objetivo: Relatar a experiência de atuação da enfermagem no cuidado transoperatório na cirurgia de transplante pulmonar intervivos. **Método:** Relato de experiência da atuação da equipe de enfermagem nas cirurgias de transplante pulmonar intervivos ocorridas no Centro Cirúrgico de um hospital de Porto Alegre, RS, Brasil. **Resultados:** Foram realizados, entre 1999 e novembro de 2014, 33 transplantes de pulmão intervivos. Apresenta-se, neste trabalho, o relato em quatro etapas: aspectos éticos e legais do transplante intervivos; preparo do Centro Cirúrgico; assistência de enfermagem no transoperatório; e encaminhamento dos pacientes para UTI. **Conclusão:** O transplante é um procedimento complexo, envolvendo muitos profissionais, demandando da enfermagem conhecimento, integração, organização, dedicação e comprometimento. O transplante pulmonar intervivos torna-se um desafio ainda maior por envolver, além do receptor, dois doadores sadios, gerando grande expectativa no sucesso da cirurgia e recuperação dos três pacientes. **Palavras-chave:** Transplante de pulmão. Doadores vivos. Obtenção de tecidos e órgãos. Cuidados de enfermagem.

RESUMEN: Objetivo: Relatar la experiencia de la actuación de la enfermería en el cuidado transoperatorio en la cirugía de trasplante pulmonar intervivos. **Método:** Relato de experiencia de la actuación del equipo de enfermería en las cirugías de trasplante pulmonar intervivos ocurridas en el Centro Quirúrgico de un hospital de Porto Alegre, RS, Brasil. **Resultados:** Entre 1999 y noviembre de 2014 se realizaron 33 trasplantes de pulmón intervivos. Se presenta, en este trabajo, cuatro etapas: aspectos éticos y legales del trasplante intervivos; preparación del Centro Quirúrgico; asistencia de enfermería en el transoperatorio; y la conducción del paciente al CTI, demandando de la enfermería conocimiento, integración, organización, dedicación y mucho compromiso. **Conclusión:** El trasplante pulmonar intervivos se vuelve un desafío más grande por envolver, además del receptor, dos donadores sanos, generando una gran expectativa en el éxito de la cirugía y recuperación de los tres pacientes.

Palabras clave: Trasplante de pulmón. Donadores vivos. Obtención de tejidos y órganos. Atención de enfermería.

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INTRODUCTION

Lung transplantation has been the treatment for patients with end-stage chronic nonneoplastic lung disease when there is no other viable or effective treatment, which enables the survival of many individuals on the waiting list for transplantation. In addition, it means greater quality of life, because advanced lung disease causes much suffering, weakness, and dependence. The advances in this therapy such as surgical and anesthetic techniques and immunosuppressive medications, among others, contribute to increase the survival and quality of life of transplanted patients¹⁻³.

Lung transplantation may occur with the organ of a donor with brain death or of a living donor, both oriented by the Brazilian legislation, which is clear and rigid. It may also be unilateral, bilateral in block, sequential bilateral, cardiopulmonary, and lobar (living donors)¹.

The donation of deceased donor organs occurs only after the confirmation of the diagnosis of brain death, with family authorization⁴. It is not always possible to use the lungs when there are multiple organ donations, because they are sensitive, and depending on the cause of death and on the drugs used to revive the individual, or even on the potential donor maintenance conditions, the organ becomes impractical for donation and transplantation.

As presupposed, the donor donation occurs when alive: a living donor donates a part of his lungs to another individual, as an alternative to the shortage of deceased donors and owing to high mortality in the waiting list⁵. In Brazil, addition to the blood, immune, and size compatibility, this process is allowed between spouses, blood relatives within the fourth degree, or any individual upon judicial authorization⁴. It is a complex procedure that requires specific infrastructure and trained staff so that the donation and transplantation occur safely.

The surgeries offer great risks and complexity because they involve, in addition to the patient with lung disease, other healthy individuals, putting them at risk to meet the need of the recipient. Therefore, it is not the first option for all cases^{3,6,7}.

The number of organ donations is low compared with the number of patients on the waiting list for transplantation. The insufficient number of viable donors is a major challenge and an hinder to perform more lung transplants, resulting in mortality of the individuals who are waiting for the organ^{2,5,7}.

The process of donation up to the realization of an organ transplant along with the care of transplant recipients involves many professionals with complex logistics, requiring dedication and commitment. The nurse participates in all the stages: donation process, preparation and orientation of the receiver, organization of the Surgical Center (SC), and patient reception and care in the perioperative period (before, during, and postoperative)⁸. It is a key role that is extremely necessary to guarantee the safety, care, and welfare of the patient⁹.

The motivation to describe the experience of one of the authors of this article, who has been working since 2012 in a Surgical Center (SC) that performs this type of transplant, is given by the specificity of this type of surgical procedure, still rare in most Brazilian SCs. Therefore, it is necessary to share the experience and knowledge acquired.

For the construction of this report, the following questions were made:

- What is it like the role of nursing in perioperative care in lobar lung transplant surgery?
- What are the ethical and legal aspects that nurses should be concerned of when participating in a living-related lung transplant?
- What is the importance of nursing in a living-related lung transplant?

OBJECTIVE

To report the experiences of nursing practice in perioperative care in living-related lung transplant surgery.

METHOD

This is a report on the experience of nursing practice in perioperative care in living-donor lung transplant surgery. The experience has been gained in the SC of one of the seven hospitals that are part of a complex located in Porto Alegre, RS, Brazil. The hospital is a Latin American reference in clinical and surgical pulmonology and has 85 beds [71 for hospitalization and 14 intensive care units (ICUs)].

The SC has three operating rooms in which 3,575 surgeries were performed in the year 2014. Besides the lung transplants, different types of lung surgeries are

performed, such as pneumonectomy, lobectomy, segmentectomy, pulmonary decortication, tracheoplasty, among others. Two rooms are occupied simultaneously for the living-donor lung transplants. In addition, some transplants of the brain-dead donors are performed, although preferably at another unit of the hospital complex, the only one exclusively specialized in this type of transplant in Latin America. Because, oftentimes, the condition of the hospitalized receptors in the ICU does not allow them to be transferred to the transplant hospital, the procedure ends up happening in the SC of the hospital specialized in pulmonology.

The nursing professionals who work 24 hours in the SC are three nurses and 18 nursing technicians. Elective surgeries take place from Monday to Saturday during working hours, while emergencies can be attended at any time.

There is only one team that performs living-donor transplantation, consisting of four thoracic surgeons, eight residents of thoracic surgery, two anesthesiologists, two perioperative nurses from the hospital and one from the staff, four circulating nursing technicians (sharing functions with the nurse in the perioperative assistance), two nurses, and a team of cardiopulmonary bypass. This quantitative staff attends on a rotating schedule, as the fixed medical and nursing teams are composed of professionals working in the SC, all of which are able to execute this type of surgery.

RESULTS AND DISCUSSION

The first living-donor lung transplant performed outside the United States occurred in Brazil on September 17, 1999, in the hospital of this report. From 1999 until November 2014, 33 living-donor lung transplants have been performed: 14 in children, 14 in adolescents, and 5 in adults, most of them patients with cystic fibrosis. Chart 1 shows the quantitative of living-donor transplants performed annually in the mentioned period.

Ethical and legal aspects of living-donor lung transplant

In the donation process, nonmeasurable virtues such as love, charity, selflessness, generosity, and magnanimity are essential, but the potential donor must decide

considering the risks involved in the decision of donating. A psychological evaluation should help by preventing any form of coercion¹⁰.

To start the process, it is essential to resolve all the legal and ethical aspects and the authorizations of the health insurances and/or of public agencies. It is also important to clarify that, for the most part, a receiver needs two donors, as each will donate a lobe (right and left); so, documents are required for all the three subjects.

In Brazil, Decree No. 2.2681¹¹, which addresses the organ donation from living body, says it is possible for any individual qualified under civil law to dispose of tissues, organs, and parts of the body for therapeutic or transplant purposes. It should be double organs or parts of organs, not compromising vital functions and physical and mental skills, so that it does not cause deformations in the donor. This Decree allows the donor to withdraw from donating at any time before the removal of tissue, organ, or parts. The living donor must specify in a written document signed by two witnesses which tissue, organ, or part he is donating, identifying the recipient's name and home addresses of both the donor and the recipient. This document is sent to the prosecutor in the donor's home town, with the due protocol on receipt¹¹.

- Requirements differ for Brazilian and foreign patients. Brazilians are required to possess:
- informed consent signed by the patient or parents, in case of a minor;
- authorization of the Public Ministry; authorization of the National Transplant System (NTS); and in case of not being carried out by the Public Health System (SUS), the patient must have a permission of the health plan.

Chart 1. Number of living-donor lung transplants performed in a hospital in Porto Alegre, RS, from 1999 until 2014.

Year	n° Tx living-donors	Year	n° Tx living-donors	Year	n° Tx living-donors
1999	1	2004	5	2009	1
2000	1	2005	3	2010	1
2001	2	2006	4	2011	1
2002	3	2007	1	2012	1
2003	3	2008	1	2013	4
				2014	1
TOTAL: 33					

For foreigners, in addition to the above-described documentations, the original documents and those proving the family relationship must be translated by a certified translator. This process takes a few days, however, and sometimes the patient's condition is extremely serious and the waiting can be fatal. Therefore, there is a race against the clock so that everything is resolved in time, as transplantation is the only option to save the life of these individuals.

The Article 9 of Law n° 10.211¹² (amended provisions of Law n° 434, from 1997), which provides for the removal of organs, tissues, and body parts for transplantation and treatment, says: "It is permitted to a legally capable person free disposal of tissues, organs and parts of his own living body, for therapeutic purposes or for transplants for spouse or blood relatives within the fourth degree, [...], or any other person, with judicial authorization, except in relation to bone marrow"¹². We noted that the requirements set forth by the Brazilian law are followed correctly.

It must be considered that this procedure could be morally questionable, challenging ethics with regard to the Hippocratic maxim *primum non nocere* (the principle of nonmaleficence // in which the first concern will be never harm the patient), because the donation by a living-donor requires a healthy individual to undergo a surgery and have an organ or part removed¹⁰. Preserving the health of the donor and excluding a potential donor, in case he is not a "great" candidate, should be the priority of the transplant team¹⁰. Each country has its specific legislation for living-donor donations, which sometimes can be very polemic¹⁰.

Preparation of the Surgical Center for living-donor lung transplant

When the procedures of donation and living-donor transplantation are authorized, the surgical procedure is scheduled (informing if adult or pediatric patient). Thus, the procedure can be organized, and the extracorporeal circulation (ECC), anesthesia team, and cardiac and thoracic surgery teams can be informed.

On the day of transplantation, the SC is reserved exclusively for this procedure as the surgery lasts throughout the day. Three rooms are prepared: one for the donor, one for the receiver, and one for the instrument table of the

cardiac team and ECC assembly. All materials must be assembled according to the age and size of the patient, following the steps in Chart 2.

According to the requests of the patient and the surgeon, the arterial cannula with a caliber should be available in the SC. Three bronchoscopes should be reserved for each donor undergoing fiberoptic bronchoscopy before the procedure. For the receiver, the fiberoptic is performed before and after transplantation. The device size should be observed in the case of the receiver being a child.

In a survey with nurses who work in SC where withdrawals of organs for transplantation are made, it is reported that, when the removal of organs is confirmed, the nursing staff initiates activities such as preparing the room, contacting the other teams, and providing materials and equipment for the surgery¹³. It is evident that the same steps mentioned for the withdrawal of donor organ after death are followed for the withdrawal of living-donor organ.

It is noteworthy that the supervision of the process is performed by the nurse responsible for coordinating the activities involving the anesthetic-surgical procedure in all the phases¹³.

Nursing Care in Transoperative of Living-Donor Lung Transplant

According to the standards of Joint Commission International (JCI) and safe surgery protocol, the nurse calls the three patients (receiver and two donors) to the SC to confirm names, birth dates (on wristbands), how long they were not receiving "nothing for oral" (NFO), the main surgeon's name, surgical procedures that will be performed, and conference of the laterality of surgeries.

The child or adolescent receiver has the right to have a companion in the operating room (OR). As most of the time the donors are their parents, the companion should be an uncle or grandparent. Chart 3 shows the steps of nursing care during the transoperative of living-donor lung transplantation.

In this category, it is observed that nursing welcomes in SC patients involved in the living-donor lung transplant, according to the recommendations for safe surgery of the World Health Organization¹⁴ and JCI¹⁵.

Chart 2. Surgical Center Preparation to perform Living-Donor Lung Transplant.

1. The nurse should coordinate and manage the activities of the SC, such as: provide material and human resources, contact teams and sectors involved in transplantation (Tx) (CME, blood bank, laboratory of clinical and immunological analyses and ICU).
2. According to the age or size of the patient, provide materials of orthosis, prosthesis, and special materials (OPSM), such as aorta cannulas, arterial venous cannulas, membrane oxygenator, hemoconcentrator, and arterial line filter. As per institutional routine, all materials should be in the SC at least 24 hours before the surgery.
3. Provide equipment: argon and electric scalpel, extracorporeal circulation (ECC) machine, nitric oxide (NO) with its connections, TCA apparatus for checking the activated clotting time, I-Stat device to check blood gas and laboratorial biochemistry with immediate results, cardioverter, thermal blanket, blood glucose test, three bronchoscopes, three infusion pumps, and focus assist.
4. Take anesthesia kits to surgical rooms with materials and drugs needed to perform: general anesthesia and anesthetic blocks, catheter placement for PAM, Swan Ganz central venous and peripheral access. Specific materials, such as Carlens Tube nº 35, 37, 39, 41 or Robertshaw tube, a Carlens Y-connector, Carlens cleaner, and Reinold and Maguil clamps.
5. Take surgery supply kits to rooms, such as gloves, gauze, bandages, syringes, needles, danulas, perfusates, catheters, and other materials.
6. Prepare the operating rooms with sterile clothing packages, sterile instrument trays for surgery, anesthetic block tray, central venous access trays, and urinary catheter tray.
7. Place the sterile instruments in the receiver room, such as thoracotomy and lung transplantation trays, vascular clamps, a stainless tray, a jug, two bulldogs, cautery pen, tip long, long scalpel handle, handles for surgical light; *Balfour* with short and long blades, vascular twin + atrium clamp, and Finocheto for transplant.
8. Take material to prepare organ table: three bags of ice, cooler, five SF bags 0.9% in 1000 ml frozen, two Perfadex bags, 1 ml of Than solution, 60 ampoules of prostaglandin, arterial cannulas, organ bag, organ perfusion equipment, Baraka child ventilation system, oxygen torpedo, sterile basin, focus assist, waterproof material, and others in major surgery kit.
9. Test material that will ventilate the organ (intact and sterile anesthesia balloon of 1 liter, with a connection in Baraka) before forwarding for sterilization.
10. Confirm in the receiver's room the specific surgical sutures, fluids, frozen solutions, urethral probes, 60 ampoules of prostaglandin, Than solution and Perfadex solution, and Swan Ganz separated according to size of the patient.

With the receiver in the OR and the first donor in the other OR, the thoracic surgical team performs fibrobronchoscopy in both, after peripheral venous puncture and anesthetic sedation. After general anesthesia and defining the side to receive the first lobe, central venous punctures, puncture for cardiac output check (Swan-Ganz) and WFP punctures are performed. Only the receiver is punctured with Swan-Ganz.

Simultaneously, the surgical teams are divided into receptor organ withdrawal (pneumonectomy) and lobe withdrawal (lobectomy) of the donor. During this period, the recipient must be ready to receive the first organ/lobe.

The preparation and constant communication between the teams is critical to the success of the surgical procedure. The bilobar transplantation with living donors is currently the best option for child and adolescent receptors because it is rare to have pediatric brain-dead

Chart 3. Nursing Care during Transoperative of Living-Donor Lung Transplant.

1. Call the patient and donor and receive them in the SC, applying the conference protocol for safe surgery.
2. Check the chart, examinations, and informed consents.
3. Prepare tables for: venous and arterial puncture, preparation of the organ, and surgical instruments table.
4. Request reserved bags at the Blood Bank.
5. Conduct patients on the stretcher to the operating rooms.
6. Provide nursing care during anesthesia.
7. Perform indwelling catheter.
8. Place venous return compression boot.
9. Assist in lateral surgical positioning avoiding pressure sores, vascular and nerve compressions, using cushions for the positioning, respecting the human anatomy and physiology.
10. Place the electrocautery board the closest possible to incision in hairless muscle tissue where it remains dry.
11. Heat the patient with thermal blanket on legs.
12. Do antisepsis of the operative field.
13. Control blood loss and volumes of other drainages for the performance of the water balance.
14. Properly store the surgical equipment sent to anatomopathological analysis as well as secretions, sent to the laboratory.
15. Request Rx technician to conduct examination.
16. Develop nursing care during the intraoperative period and inform the shift of patients to the ICU nurse.
17. Monitor patients on stretcher, from the SC to the ICU until they are transferred to the ICU staf.

donors. In such cases, the best solution is through bilobar lung living-donor transplantation, with family members being donors for the receptor^{1,16}. The surgical technique is the removal of the lower lobes of the donor and implementation in the recipient after bilateral pneumonectomy. Thus, it always involves two concurrent operations: bilateral pneumonectomy for transplantation in the receiver and lobectomy in the donors. While one team starts the pneumonectomy in the receiver, another team starts the lower lobectomy of the first donor chosen¹⁷.

Soon after the donor lobe is removed, it is subjected to the preservation process on the specific table, with all the material necessary for its preparation by a surgeon. Sometimes one segmentectomy is required, depending on the size of the recipient patient and the organ to be transplanted. The removed lobe is placed in a sterile basin with cold saline solution in which an improvised system maintains ventilation through a Baraka by bronchial intubation. A vascular cannula is inserted into the pulmonary artery and allows the perfusion with 1 liter or more of Perfadex (solution for organ preservation) activated by Than solution (Perfadex activator), until the lobe becomes completely free of the donor's blood¹⁶.

After the first pneumonectomy in the receiver, the implant of the donated lobe begins. The choice of the first lung to be replaced by the lobe of one of the donors is carried out through an analysis of the receptor and donor's lobe sizes¹⁸.

In some cases, NO is used as a support for pulmonary hypertension (PH). If not efficient, a cardiopulmonary bypass (CPB) is performed, causing the surgery to last longer. In such cases, the cardiac team comes in to fix PH or bleeding. Another possibility for transoperative cardiopulmonary support is the extracorporeal membrane oxygenation (ECMO), used when ventilatory assistance for the postoperative is needed.

The pressure depends on the rates of Swan-Ganz catheter values, which are installed in a central vein and can read some debts, such as pulmonary artery pressure and cardiac output. Acceptable values of pulmonary artery pressure are up to 55 mmHg¹⁹. The NO has pulmonary arterial vasodilator function, helping the PH control after clamping the pulmonary artery. There are cases in which the pulmonary arterial pressure does not respond to the NO, requiring partial ECC and no stopping or cooling the heart. This is only for circulatory support and/or

reduction of pulmonary artery pressure, guaranteeing a good ventilation¹⁷.

The surgery at the receiver is performed in two surgical times: lung transplantation of the right lower lobe and left lower lobe. In exchange for decubitus to transplant the other side, there will be an X-ray. The same procedures are repeated for the other side. The next donor enters the OR and the same procedures are performed.

In SC, the nurse coordinates the ORs, providing materials and equipment that will be needed, and assists the patients with the organization and documents conference, meeting all legal procedures that permeate this kind of donation and transplantation. The nurse also makes records of care and management processes, working seamlessly to other team of professionals in this macroprocess, seeking quality and safety in the perioperative care of living-donor lung transplant.

A recent study conducted at the same hospital of this report aimed the main nursing prescriptions in the medical records of patients undergoing lung transplantation in the immediate postoperative period. It identified the prescribing of general care of postoperative recovery of large surgeries and not individualized to the patient in the postoperative of lung transplant. It is evident in the report that, although many of the materials used during surgery of living-donor transplantation are also used in major surgery, there are some unique materials for this procedure; thus, it is considered important that the nurse who works in SC knows these particularities.

Referring living-donor lung transplantation patients for ICU

By identifying the proximity of the end of the surgery, the nurse of the SC passes, via telephone, the transoperative shift for the ICU nurse and requires the ICU bed for the SC. After having the surgical procedures finalized, chest drains identified, surgical wounds closed, and nursing evolution of transoperative performed, the patients are transferred to the ICU. The first donor is transferred, followed by the second donor and the receiver.

The information is passed in advance to the ICU nurse, in order to prepare and organize the box of that sector, such as: drains and access places, which are essential; names; ages; attendance numbers; any allergies or comorbidities, such as systemic hypertension (SH) and/or diabetes

mellitus (DM); ventilatory conditions, and complications in the transoperative period. It is also important to communicate, in order to manage the family anxiety, what is the relationship with the receiver, because three members of the same family will be at the same sector, all wondering about the most important person of this event: the receiver.

Surgical procedures for the donation and living-donor lung transplantation have high complexity and require intensive postoperative care, in addition to general postoperative care after major surgeries. "Hemodynamic monitoring, recognition of hypovolemia, control of the ventilation system, suction of secretions, and pain management" should be individualized, that is, focused on the needs of each patient⁹.

Aiming the continuity and quality of care, nursing records and shift changes are essential, because they involve multiple professionals and effective communication between the various team members who work in the transoperative process. Records as shift changes are essential for the continuity of care and safety of patient¹⁴.

FINAL CONSIDERATIONS

In this article, we reported the experience of nursing practice in transoperative care of living-donor lung transplant surgery. We made a reflection from the presentation and discussion of four stages called: ethical and legal aspects

of living-donor transplantation; preparation of SC; nursing care during surgery; and referral of patients to ICU.

The nurse, integrating the multidisciplinary team working in the donation process and living-donor lung transplantation, makes these surgical procedures feasible, which carry, in essence, the magnitude and the expectation of survival. It is noteworthy the importance of the nurse's role in the logistics of this type of surgery and the responsibility and duty regarding legal claims involving the donation and transplantation.

Any type of transplant is a complex and challenging procedure, involving many professionals and demanding knowledge, integration, organization, dedication, and commitment from the nursing staff. The living-donor transplant becomes an even greater challenge because it involves, in addition to the receiver, two live and healthy donors, generating great expectation for the success of the surgery and recovery of the three patients. Nursing should plan and meet all legal, ethical, care, and management requirements that the macroprocess of donation and living-donor lung transplantation demand.

The touching efforts of parents trying, sometimes desperately, to save their child ends up spreading a sense of solidarity across the group, particularly, in the nurses who operate this macroprocess. The solidarity of the donor and the recipient's life expectancy produce an emotionally dense panorama, which makes explicit the challenge and the responsibility of nursing practice in living-donor transplantation.

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