The criterion of proportionality in the activation of Left Ventricular Assist Device implants: the method of “four boxes” to analyze the pre-implant phase

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Abstract

Background. Life-saving technologies have completely changed the normal conception of medical treatments. Left Ventricular Assist Devices (LVAD) can prolong survival for patients who are not candidates for heart transplantation.

In order to analyze the pre-implantation phase, which involves a shared-decision making process before activation of the device, attention should be paid to the criterion of “proportionality” in order to properly assess the risks and benefits of implantation.

Aim. The aim of our analysis is to provide an useful tool for the assessment of LVAD proportionality during the physicians’ decision making.

Methods. The method of the “four boxes”, developed by Jonsen et al, was chosen to analyze the notion of proportionality and the other main ethical issues regarding LVAD activation in adult patients.

Results. Medical issues are not the sole factors, which influence the choice of implantation by patients. Indeed, patient preferences, his/her quality of life, and contextual features should be taken into consideration when proposing LVADs: these factors are as important as clinical issues where outcomes are concerned.

Conclusion. In order to assess the proportionality of such a device, we present, discuss and examine, in the framework of the pre-implant phase, the content of each topic treated by the “four boxes method”, that is, an essential tool for the assessment of the proportionality of the treatment for LVAD candidates. Clin Ter 2019; 170(1):e61-67. doi: 10.7417/CT.2019.2109

Key words: heart failure, LVAD, four-boxes method, proportionality

Introduction

Over the past decades the prevalence of cardiovascular diseases, metabolic syndrome and Heart Failure (HF) has risen significantly in the adult population, especially in developed countries, and specifically among “over-70’s” (1). These patients, especially those with Mechanical Circulatory Supports (MCSs), have seen an improvement in overall survival rates, thanks to more efficient diagnostics, specific care focused on cardiovascular conditions and therapeutic innovations (2).

Although heart transplantation is the gold standard treatment for patients who develop end-stage HF resistant to medical therapy, MCSs can be used to ease the load on the failing ventricle and to maintain sufficient end-organ perfusion, with a good survival rate (3,4). Life-saving technologies have proliferated dramatically and have completely changed what the normal conception of medical treatment used to be (5). Among MCS devices, Left Ventricular Assist Device (LVAD) has become an advanced treatment for patients with end-stage Heart Failure. Such new “heroic measures” have paved the way for ethical, social and cultural challenges (6-8).

The aim of this paper is to analyze the advantages and disadvantages of undergoing LVAD implantation, focusing on the “proportionality” aspects of this treatment option in the pre-implant phase in adult patients.

Proportionality is not a monolithic criterion. As Pellegrino suggests, it is a notion which takes into account three different elements: effectiveness, benefits and burdens (9).

Effectiveness concerns the clinical appropriateness of a treatment, i.e., its capacity to alter the natural course of a disease. Benefits focus the attention on the patient’s values and preferences, with the aim of respecting the patient’s life goals. Finally, the third element takes into account burdens, which are defined as the “physical, emotional, fiscal, or social costs imposed on the patient by the treatment” (10).

The method of the four boxes proposed by Jonsen et al. (11) may be a useful tool to analyze and discuss all the relevant elements that have to be taken into account in the decision-making process between patients, family members, and/or caregivers and health care professionals. The four topics to be equally considered using this methodology are: 1. Medical indications; 2. Patient’s preferences; 3. Quality of life (QOL) 4. Contextual features (Table 1).
As with many other therapeutic options, LVAD implantation is almost always subject to the assessment of its proportionality by the physician; in order to make such a judgment, clinicians have to take into consideration a myriad of factors, such as the patient’s consent-related predictors and the necessary caregiver’s approval for the treatment.

### Medical indications

A diagnosis regarding heart-pump function is the first criterion that must be taken into account. In general, candidates for long-term circulatory support should fulfill clinical, functional and hemodynamic criteria for heart transplantation. Patients with advanced systolic HF, reduced left ventricular systolic function or other limitations determined by HF are appropriate candidates for LVAD implantation.

Over the past decade, LVAD continuous flow devices have replaced larger pulsatile flow pumps and currently represent 95% of all implants (12). Since 2007, the new generation of LVAD pumps have been very small, longer-lasting and surgically implantable into the chest or upper abdomen; they are connected via a cord to an external controller that extends out of the body (13).

Despite these innovations, several clinical collateral effects may occur after LVAD implantation: neurological complications, infections leading to highly probable sepsis or bacteremia, device malfunctions and subsequent replacement, right heart failure, and even death (14-16). The first indication for LVAD use was in patients with acute but most probably reversible HF as a “bridge to recovery” (BTR). Later, LVADs were also implanted in patients awaiting donor hearts, again as a “bridge to transplant” (BTT), i.e. a temporary solution to keep hope alive in patients waiting for a suitable organ. More recently, however, LVADs have been used as Destination Therapy (DT) for patients who are not candidates for heart transplantation (17). In this case, the device implant constitutes the last chance for survival for patients with end-stage HF whose organ will never be replaced. Indeed, patients receiving a LVAD DT as a permanent support have to face the everyday challenges of such a device for the rest of their lives. As opposed to other MCS, and taking into account the every-day complexities of such a device, the choice of having an LVAD implanted requires consent by both the caregiver and the patient. This means that the ongoing presence of the caregiver is a necessary condition for approval of the procedure. Without any caregiver support, the physician is not allowed to propose a LVAD, since the patient alone would not be able to handle the every-day challenges of the device.

Compared with the first-generation pulsatile pumps, reducing its size and including a continuous-flow pump. As Miller et al. argue, during the last decade LVAD models, implantation techniques, and follow-up routines have changed dramatically (17). All of these changes have led to the modification of the general criteria for patient selection.

As regards strictly clinical considerations, severe pulmonary hypertension is not an absolute contraindication to LVAD implantation, as it is instead for heart transplantation. However, absolute contraindications are: systemic diseases with less than two year-survival rates, metastatic and advanced cancers, return of malignancy within five years, severe renal or hepatic dysfunction, severe pulmonary disease, active severe bleeding, severe peripheral artery disease, multi-organ dysfunction diseases and others (17, 18). Age is a controversial issue in the selection procedure of adult candidates for heart transplantation and LVAD implants. However, according to Miller, while transplant waiting lists give priority to younger patients, older patients have an equal chance of being eligible for LVAD implantation (17). Moreover, a study involving 30 patients over 70 years of age, showed a survival rate comparable to younger patients, with good outcomes and quality of life (QOL) (19). Even though age is not a strict selection criterion, it has to be taken into account especially regarding the potential occurrence of age-related diseases which can complicate the patient’s health status. Obesity is considered only as a relative contraindication; while in many centers heart transplantation is contraindicated in patients with a body mass index (BMI) of over 35, the patient may be eligible for LVAD (20-21).

Since the proposal for this therapeutic option implies the patient’s capacity, along with the caregiver, to look ahead to the future and to take into account both potential risks and benefits, the clinical diagnosis is fundamental in order to as-
sess the proportionality and the impact of such an implant. Although undergoing LVAD implantation may technically prolong the patient’s life, the first post-implant period may be characterized by poor outcome and suffering. Some recipients cannot cope with this treatment and may request that the device be removed, because the burdens that are involved are intolerable (22, 23).

Patient preferences and the principle of autonomy

Before LVAD implantation, clinicians should assess whether the patient has a positive attitude towards the therapy. In addition to weight and age factors, psychological tests and a social evaluation should be carried out in order to assess the patient’s effective awareness so as to guarantee an accurate selection process and prevent eventual post-operative complications (24).

In accordance with the law in many countries, everyone has the right to accept or refuse medical treatment (25,26). It is precisely the proclamation of the principle of autonomy that raises many ethical questions where patients’ desires to undergo LVAD implants are concerned. The patient’s personal autonomy depends on the expression of his/her preferences: it is important to take all of the values, psychological, and sociocultural aspects which have influenced their lives into consideration.

Patient autonomy in LVAD decisions is not considered in absolute terms (27). The presence of willing and able informal caregivers may be a determining factor in patient selection. Autonomy should be indeed considered to be a relative factor. As stated in the 2013 Guidelines for Mechanical Circulatory Support, published by the International Society for Heart and Lung Transplantation, the sole patient’s consent may not be sufficient, and the lack of a caregiver may be a contraindication to the patient’s LVAD implantation (28).

Since LVAD contributes to extending life expectancy, even though it does not guarantee immediate positive outcomes, the foreseeable medical complications require ongoing vigilance as well as lifestyle changes by the patient. An increasing amount of literature suggests ways to facilitate the patients’ consent to the implantation of this device (29, 30).

However, it is important to underline that patients’ attitudes towards LVAD implant change radically according to the strategy adopted: in the case of BTT, the patient may have considered the therapy only as “transitory” while waiting for heart transplantation; on the other hand, in a DT scenario, the patient might feel resigned to a life where he/she would be totally dependent on a machine for the rest of his/her days.

According to Rizzieri, surgical implantation should not be initiated until the clinician is convinced of the patient’s complete understanding of the possible risks and related benefits, the reasons underlying the decision to implant, and his/her awareness of post-implantation collateral effects (31, 32).

Since patient preferences often change, especially in response to clinical developments, respecting patient autonomy means reframing the discussion regarding patient’s wishes both before implantation and during the follow-up phase. Tanner et al. suggest that clinicians and health care professionals should consider values, health-care goals, and patients’ wishes on an on-going basis, rather than basing them on a single event (33).

LVAD candidates have to undergo mental health assessments before implantation. Psychological pre-operative evaluations have an important weight on post-implant outcomes. A team composed by mental health professionals, including psychiatrists, psychologists and social-workers, should guarantee the reduction of poor post-surgery outcomes. Generally, a pre-implant diagnosis of psychiatric disorder does not directly affect the patient’s ability to consent to or refuse treatments. The term “competence”, which is usually used to define a legal status necessary to consent to health care, is different from “capacity”, which describes “a functional construct or measure of actual ability” (34). In other words, retaining decisional capacity means being able to refuse or to consent to health care autonomously.

In a study conducted by Guidy-Grimes et al., the majority of psychiatric in-patients retained decision-making capacity (25). According to another study which involved 150 patients in 11 clinical centers from 2006 to 2009, a connection between a previous history of depression and the development of infections was found (35). In addition, a recent analysis carried out by Bruce et al., suggests that the patient’s evaluation should be carried out by considering five different factors: physical vulnerability and frailty, assessment of psychological disorders, perception of QOL, capacity to maintain social networks, and behavior (36).

Quality of life: a balance between patient’s preferences and clinical conditions

Improvements in technology have completely changed the traditional goals of medicine. While the general goals of medicine include preserving life, preventing death, promoting health and alleviating suffering, the physician’s role is also to transcend the physical dimension and to comprehend the personal aspects of the life of every patient. To this aim, as James Walter pointed out, QOL should be understood as the relationship between the patient’s clinical conditions and his ability to maintain his own values while pursuing his life goals (37).

New continuous-flow LVADs have significantly improved expectations of survival and QOL in end-of-life trajectories. As mentioned before, during the last decade technological transformations and improvements have significantly changed the MCS devices, especially LVADs, thereby changing the general criteria for patient selection.

In a recent study by Fendler et al., 65% of patients with LVADs had favorable outcomes, whereas 33% had poor results. In this last group 23% deaths, 10% poor QOL, 3% recurrent HF and 1% severe stroke were registered (38). Although 33% of patients with poor outcomes may appear high, the same patients without the device would have died within one year. Given this perspective, extending life without guaranteeing improved QOL may not be considered as an acceptable outcome for patients suffering from HF. Therefore, it is fundamental to re-evaluate the concept of QOL.
in LVAD settings. Until a few years ago, studies focused their attention only on mortality and morbidity; nowadays, however, the evolution in technology has shifted the focus to outcomes and subjective health status.

In 2013, Sandau defined five domains belonging to the definition of QOL (39).

The first is the physical domain, i.e. the physical dependence on the device. It has been shown that patients do however begin to gain independence through co-existing with the device and establish a sort of “new normal” lifestyle.

The second, i.e. the emotional domain, is described as a range of feelings including depressive symptoms and anxiety which are related to the dependence on LVAD functions and anger towards healthcare professionals. Patients’ adaptation to a “new normal” life seems to stimulate the development of new feelings such as pragmatism, sense of humor and acceptance of lack of control.

Regarding cognition, the third domain, the majority of patients express difficulties with concentration and poor memory in the initial post-operative recovery period.

The fourth, namely the social domain, is also important, because participants may be grateful for the support provided. Instead, many other recipients express their frustration about the impossibility of carrying out their family responsibilities and their need to be physically and intellectually productive. Recipients’ self-perception makes coming back to a real “normal life” harder.

The fifth and last sphere concerns spirituality and the need for patients to regain faith. Campbell defines QOL as a “sense of well-being that stems from satisfaction or dissatisfaction with the areas of life that are important to [a person]” (40). Satisfaction depends on the achievement of personal goals, based on subjective values and beliefs. When these personal values are not respected, satisfaction and perception of individual QOL tend to decrease.

As for the definition of autonomy, the patient’s QOL may also be influenced by caregivers or palliative health care providers. Health care support during pre-implant discussion is in fact essential to the establishment of a therapeutic alliance between patients and physicians both before the implant and during the follow-up. During the pre-implant phase, healthcare professionals should create a shared space in which patients can feel free to discuss their desires, wishes and fears. As the preferences of patients change with their health status, the health care team should assure a milieu for dialogue where the goals of the treatment, wishes and values should be listened to and respected or, in some cases, challenged.

It is necessary to point out that the numerous clinical complications which emerge after the implantation involve parallel changes in the caring relationships (41–44). Poor relationships between patients, relatives and healthcare professionals can lead to conflicts and stress, which negatively influence the entire outcome. Inadequate preparation of caregivers can also become a stress factor. Relatives would generally accept anything in order to keep their dear ones alive; however, this “technological imperative” requires both the patient’s and the family’s collaboration to manage every possible daily complication (44). A recent study by Kirkpatrick shows how caregivers’ lives change dramatically: a disproportional burden surpasses their initial expectations and their own QOL generally decreases (45). Considering the overall disproportionate burdens they handle, which will inevitably affect the outcomes of their LVAD patients, it is important to discuss how to improve caregivers’ awareness and preparation for LVAD therapy.

**Contextual conditions: several burdens influencing patient outcome**

The discussion regarding contextual conditions includes the presence of willing and able caregivers, who play a fundamental role in QOL judgements as emphasized above, financial burdens on the health care system, and geographical difficulties involved in patients’ being able to the appropriate specialized centers.

Caregivers are fundamental figures during both the decision-making and the post-implantation phases. Informal (family member) caregivers should check their own competences and availability before guaranteeing on-going support to a LVAD candidate (45). The most important task is to accompany a patient until the final discharge after implantation. However, these responsibilities contribute to creating a significant level of stress for them, and may interfere with the patient’s improvement and outcome. In the study led by Kirkpatrick on QOL and caregivers’ stress level, the authors described the peculiar involvement of caregivers during the patient’s decision-making process (45). Usually, their stable presence and support may contribute to the patient’s consent during selection. Despite their “Good Samaritan” feelings, the study shows that the caregivers interviewed were not sufficiently trained to handle the numerous day-to-day tasks that they had to face: they frequently mentioned the disappearance of their independence and a deep sense of responsibility and fear for their relative’s health status. This fact indicates that both caregivers and providers need to receive training and support for both pre and post-implantation stressors. Living with a LVAD can facilitate patients, as it gives them the chance to restart their lives at home. On the other hand, lifestyle changes can increase physical, psychological and financial strains on caregivers. Caregivers also report poorer physical health, which exacerbates depression and stress disorders (46). Since the presence of caregivers represents one of the main factors influencing the patient’s selection to undergo a LVAD implant, this fact raises some ethical challenges, e.g. what might happen if there were no formal or informal caregiver, thus preventing the patient from becoming a candidate for the implant.

The main difficulty related to contextual conditions is the need for the presence of a caregiver able to handle the every-day challenges of the device. However, we argue that physicians’ assessments of proportionality are a complex matter, as both patients and caregivers have not yet experienced the difficulties of living with a LVAD. Given that the caregiver’s consent is required for implantation, the relationship between the patient and the caregiver becomes one of obligation, which prevents both from expressing themselves freely. In fact if on the one hand the former consented first to the treatment, the latter would not be completely free to refuse; on the other, if the caregiver were asked to give his/her approval first, the potential refusal could determine the
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patient’s “death sentence”. Because of this ethical glitch in the consent process, we suggest that the 2013 International Guidelines for MCS be reconsidered, which underscore that the proportionality of LVAD implants must necessarily depend on a parallel process of consent involving both the caregiver and the patient. The physician is not allowed to propose a LVAD DT if the patient does not present a caregiver. In such cases it is not even considered as a viable alternative option because the patient with LVAD needs to have 24-hour a day, 7-day a week support. We suggest that whenever the patient is accompanied by a caregiver, physicians should propose the LVAD treatment both to the patient and the caregiver, initiating the process with a therapeutic assessment in order to ensure the patient’s wellbeing.

With regard to financial burdens, comparing the implantation of the device to heart transplant surgery, LVADs are not a scarce resource, but as a recent study shows, costs of LVAD implantation generally increase over the first year after the device implantation (47). In fact, index admission total costs for LVAD patients doubled compared to transplant candidates: for LVAD recipients, total costs of care for index admission, procurement, blood products and additional admissions during the follow up were $411,414.00 per patient compared to $189,998.00 spent for each candidate for heart transplants (47).

Over the past 10 years the improved technology of continuous-flow pumps has brought about a 50% cost reduction for LVAD related hospitalization (48).

The final problem to be considered concerns the patients’ limitations regarding the choice of trained physicians, and the shortage of appropriate centers when there is a conflicting relationship between patient and physician. In many countries the main care centers are located only in metropolitan areas. Thus, patients who live in rural areas may find it difficult to reach the closest center (48). Long distances represent a significant limitation for patients and families when choosing whether to accept and to undergo LVAD implantation.

Conclusions

LVAD implantation is a life-saving technology for patients with end-stage HF. These devices are nowadays considered a viable alternative for those patients who are not eligible for heart transplantation. In addition to LVAD use as BTT and BTR, LVAD implantation as a destination therapy is a permanent treatment for patients with advanced heart failure who can now survive even without a new heart. In order to guarantee a positive outcome during patient follow up, the healthcare team has to pre-emptively express a judgment of proportionality based on the “four factors”.

The clinical analysis takes into account parameters which would require eventual exclusion from implantation, an overall evaluation of the risk-benefit ratio, and possible side effects.

Patient preferences should be assessed respecting five different and complementary domains: the physical dimension, the psychological and the social sphere, a positive self-perception of quality of life, and spirituality. Patients with previous psychiatric disorders are not excluded from the selection process, and the majority of psychiatric in-patients retained decision-making capacity.

Quality of life is evaluated by considering every patient’s ability to achieve life goals and to pursue personal values and beliefs. An evaluation of quality of life is strictly related to contextual conditions, e.g. factors regarding caregivers and financial burdens.

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Disclosure section

The authors state that they do not have any conflict of interest.

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