Successful Delivery in a Patient With Left Ventricular Assist Device and Unplanned Pregnancy

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We report the case of a woman supported by a left ventricular assist device (LVAD) who presented at 20 weeks of gestation and decided against recommendations to continue with her pregnancy. This was managed with well-developed plan for a multidisciplinary team approach. With close and regular follow-up and regular adjustment of the patient's medications and LVAD parameters, successful delivery and outcome for both the mother and the newborn were achieved.


Left Ventricular Assist Device (LVAD) is an emerging therapy for acute and chronic heart failure (HF). LVAD support has tremendously improved the quality of life for patients because of the effective control of symptoms. However, there is a lack of information regarding return to sexual activity in woman after LVAD placement [1]. Conception while a woman is using LVAD support is considered a contraindication, and pregnancy is considered a high risk for both maternal and fetal adverse events because of hemodynamic changes, teratogenicity of the medications needed for treating HF, and the stress of delivery. To the best of our knowledge, only two cases have been reported in the English literature about a woman becoming pregnant during LVAD support [1, 2].

A 36-year-old woman was admitted with acute decompensated HF due to nonischemic cardiomyopathy. She underwent emergent extracorporeal membrane oxygenation, supported for 2 weeks, then transitioned to outpatient therapy with inotropic agents. As the cardiomyopathy progressed with left ventricle ejection fraction (EF) of 20%, she ultimately underwent implantation of an LVAD Heart Mate II device 2 months later as a bridge to transplantation. Her postoperative course was uncomplicated. She was the mother of three children she was advised that pregnancy was contraindicated, and she agreed and had a Mirena (levonorgestrel-releasing intrauterine device [IUD]) placed. She presented approximately 9 months later and described fatigue and multiple syncopal episodes. The result of a pregnancy test was positive, she reported that the IUD had accidentally fallen off, and her last menstrual period was about 5 months prior. Obstetric ultrasonography showed a healthy single fetus with an estimated gestational age of 20 to 21 weeks, without obvious congenital malformations. Transthoracic echocardiography revealed an EF of 25% with LV dilatation and global hypokinesis. Metoprolol succinate and aspirin were continued, and the lisinopril, furosemide, spironolactone, and warfarin were discontinued. She was given heparin in transition to enoxaparin.

In consideration of the complexity of the situation, she was counseled regarding the risks of continuing with the pregnancy, including the chances of decompensating with the progression of gestational age, and the chances of death for both mother and fetus. She decided to continue with the pregnancy. At this point a comprehensive multidisciplinary team plan of action was drafted for all possible outcomes, along with emergency scenarios including obstetrics and LVAD-related problems, as shown in Figure 1. She was discharged with a close weekly follow-up by the obstetrics and HF cardiology services for the next 10 weeks, and cesarean section was planned for 32 weeks of gestation.

The patient was electively readmitted at 30 weeks of gestation, and fetal monitoring was performed twice daily. Betamethasone was given at 30 weeks and then a day before the delivery to help in maturation of the fetal lung. The scheduled cesarean section along with tubal ligation occurred in a cardiothoracic operating room, invasive monitoring including a Swan-Ganz catheter was used, and transthoracic echocardiography (TEE) was also performed and revealed an EF of 5% to -10%. The newborn’s birth weight was approximately 2000 grams (within normal expected weight for gestational time), and his Apgar scores were 2, 3, and 3 at 1, 5, and 10 minutes respectively. The newborn did not have any congenital malformations or defects. He was intubated for 1 day because of apnea and admitted to the neonatal intensive care unit. However, he needed high-flow nasal cannula support for 2 weeks before being converted to room air, and was discharged home 5 weeks after delivery. The mother was give heparin and transitioned to warfarin within 12 hours. The patient did well and eventually was discharged within 8 days. The placenta weighed 316 g; the pathologic examination showed a homogeneous parenchyma with no discrete lesions, medium-caliber vessels, and minimal subchorionic fibrin depositions; and the age of the placenta corresponded to 32 weeks of gestational age. There were no specific changes in comparison with the placenta of healthy mothers.

The LVEF was at 25% before and during pregnancy, decreased to 10% at delivery, and increased to the patient’s baseline at 25% as the heart recovered after delivery. The LVAD parameters underwent frequent adjustments; when the pregnancy was discovered the pump speed was at 9400 rpm, and it was increased to 9600 rpm at 28 weeks of gestation and to 3800 rpm at 30 weeks and during...
Fig 1. Patient follow-up and management algorithm. (C/section = cesarean section; CVCC = cardiovascular critical care unit; ED = emergency department; HF = heart failure; ICU = intensive care unit; L&D = labor and delivery; MFM = maternal-fetal medicine; NICU = neonatal intensive care unit; OB = obstetrics; OP = outpatient; OR = operating room; PACU = post-anesthesia care unit; RN = Registered Nurse; VAD = ventricular assist device.)
delivery. The speed was decreased to 9600 rpm and then to 9400 rpm at 1 month and 4 months after delivery, respectively. No significant change in lactic acid dehydrogenase was found; the range was 150 to 350 U/L before pregnancy and 140 to 371 U/L during and after pregnancy.

Comment

During pregnancy the maternal cardiovascular system undergoes enormous structural and functional alterations to adapt to the requirements of fetal development and growth [3]. Understanding the normal cardiovascular adaptations in healthy pregnant women and in patients with chronic cardiomyopathy is vital for management of the LVAD, and continuous adjusting of its parameters during pregnancy is imperative to obtain better outcomes for both mother and neonate.

Meah and colleagues [4] in their meta-analysis review hemodynamics and cardiac output (CO) during pregnancy demonstrated that the CO increased up to 31% of nonpregnant value, with a peak early in the third trimester. The heart rate increases in a linear pattern, with a peak late in the third trimester. The stroke volume increases to a peak of 10% late in the second trimester, with a corresponding increase of the left ventricular mass of 40 g (34%), by contrast, the main arterial pressure remains stable throughout pregnancy. AU: in all pregnant women, or in this case? During the third trimester, the LV end-diastolic diameter is expected to increase with an increase in mitral regurgitation [2].

Women with CHF are at increased risk for both maternal and fetal adverse events because of the hemodynamic alterations during pregnancy [5]. Although the LVAD might bring excellent hemodynamic support to a patient with end-stage CHF, nonetheless there are few reports about the role of LVAD during pregnancy and the potential risk to the fetus, which includes uncertainty about the effects of the LVAD on the hemodynamics of placental blood flow and the blood flow of pregnant patients [2]. The constant changes in the patient’s hemodynamics and the cardiac parameters of the pregnant patient need to be closely monitored and followed by adequate adjustments of the LVAD parameters by increasing the LVAD output and speed. This also should continue after delivery while the physiology of the patient’s hemodynamics returns to its condition before pregnancy. Harmful and teratogenic medications, such as angiotensin-converting enzyme inhibitor and warfarin, should definitely avoid. Careful use of diuretic agents is recommended because aggressive diuresis could cause a decrease in the fetal circulation flow.

Delivery in this case was performed by cesarean section but could be done by vaginal delivery [2]. The growth of the fetus and uterus theoretically should not affect the extraperitoneal location of the driveline; however, care must be taken not to disrupt the driveline if a cesarean section is performed.

This case highlights the importance of coordination of care. A multidisciplinary team approach should be initiated early so as to plan for the delivery and achieve better outcomes. Discussion of potential outcomes and adverse events that can potentially restrain the mother from continuing with such a high-risk pregnancy is prudent. Another important aspect is the management of medications and stopping all heart failure medications with potential teratogenic effects; appropriate alternatives when available should be instituted. Anticoagulation agents are vital in pregnant patients with LVAD support because pregnancy is a prothrombotic state independently of the LVAD.

This case, along with the two previously published cases [1, 2], constitute a proof of the concept that LVAD can successfully support the hemodynamic demands of a pregnancy in a patient with end-stage HF. The appropriate fetal development and the normal appearance of the placenta on pathologic examination in this case also indicates that human embryogenesis and growth can occur with continuous-flow predominating. Although the outcome in this case was favorable for both mother and newborn, the lack of data on placental blood flow and pregnancy risks during LVAD support continues to make pregnancy a contraindication after its placement.

References