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Perioperative Management of Pheochromocytoma Resection in a Patient with a Continuous Flow left Ventricular Assist Device

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1. Introduction

Left ventricular assist devices (LVAD) are currently utilized as both bridge and destination therapy for patients with end-stage heart failure. Current generation LVADs provide continuous blood flow which has been shown to increase sympathetic tone. Pheochromocytoma is a rare neuroendocrine tumor which classically presents with episodic hypertension, palpitations and headaches. Careful perioperative management with alpha blockade is required to prevent cardiovascular complications, specifically hypertensive crisis. Here we present a description of perioperative management of pheochromocytoma in a patient with a continuous flow LVAD.

2. Case Report

A 70 year old male with a history of mixed ischemic and non-ischemic cardiomyopathy, hypertension, hyperlipidemia, atrial fibrillation, coronary artery disease requiring percutaneous coronary intervention, obesity, and obstructive sleep apnea presented with refractory ventricular tachycardia. Despite aggressive attempts at medical management and ablation, his VT could not be controlled and durable left ventricular assist device (HeartMate III VAD, Abbott) was implanted. During his advanced therapies evaluation, elevated levels of metanephrine were identified. Subsequent imaging diagnosed pheochromocytoma (see Fig. 1) and surgical resection was planned.

Seven days prior to scheduled surgical resection, the patient was admitted to the intensive care unit for alpha blockade and heparin bridging. Guideline recommendations for pheochromocytoma management include volume expansion, high sodium diet and alpha adrenergic receptor blockade. Given the patient's history of advanced heart failure, diuretics were held but he has not supplied a high sodium diet or given intravenous fluid. The patient was continued on carvedilol 3.125 mg twice daily. Phenoxybenzamine was initiated at 10 mg twice daily with daily monitoring of orthostatic vitals. While the patient remained asymptomatic throughout, a measurable drop in mean arterial pressure from his baseline 80 mmHg to 60−65 mmHg was noted after phenoxybenzamine reached 40 mg orally twice a day. He also exhibited episodes of asymptomatic orthostatic hypotension.

Perioperative orthostasis is the normal goal of uptitration of alpha blockade however this proved difficult. The LVAD likely compensated for the hemodynamic changes thereby preventing orthostasis. Induction of anesthesia was attained utilizing propofol and sufentanil in titrated doses and maintained with narcotics and inhaled sevoflurane. Desflurane was avoided specifically due to its sympathomimetic side effects. Muscle relaxation was

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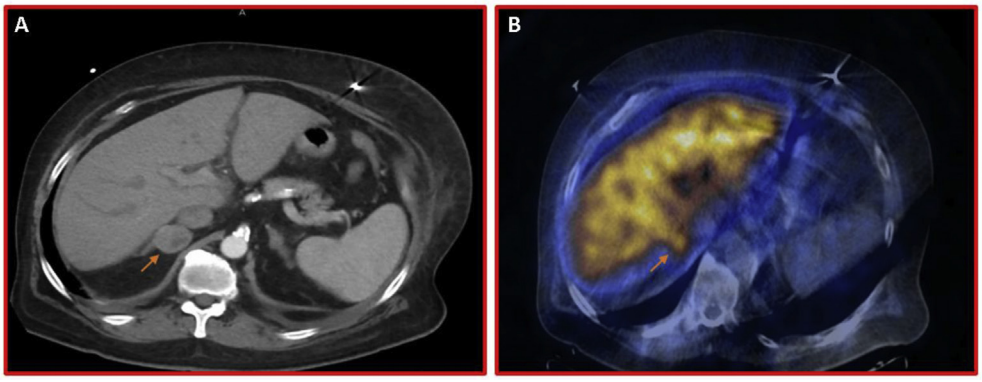

Fig. 1. (A) Abdominal CT imaging demonstrating right adrenal tumor (red arrow). (B) Metaiodobenzylguanidine (MIBG) scan showing increased activity of right adrenal gland raising suspicion of pheochromocytoma (red arrow).

attained with cisatracurium. Mean pressures during the procedure were kept within 20% of starting mean pressures with maintenance of anesthesia. Further vasodilators were not required although the mean pressures were in the 90 range. More aggressive hypertensive management was avoided to ensure cerebral perfusion during the case and cerebral oximetry was used to monitor cerebral perfusion. Two separate times during dissection systolic blood pressures spiked to greater than 220 mm Hg and were treated with pausing of dissection of small doses of IV phentolamine (0.1 mg). LVAD flows dropped from 5.2 lpm with a PI of 2.0–4.8 lpm with a PI of 2.4 during these events. Once resection had taken place, an epinephrine infusion was started at 0.01 mcg per kg per min and titrated to 0.04 due to an acute drop in blood pressure. Further vasoactive support with vasopressin (started at 0.02 units per minute) was required. Contrary to the norm, volume was restricted during the case in light of the severe cardiac status of the patient (660 mL of lactate ringers and 500 mL of normal saline). Pain control was attained by a post operative transverse abdominis plane block using equal doses of 0.25% Bupivacaine and liposomal Bupivacaine.

The patient tolerated surgical resection without complication. Nitroglycerin was used to control elevated blood pressure perioperatively, and this was weaned off in the following 24 h. The patient's anticoagulation regimen for his LVAD was resumed on post-operative day 1, and he was transferred out of the intensive care unit on post-operative day 2. After surgery, he did develop volume overload which was treated to intravenous furosemide before transitioning the patient to his home regimen of torsemide. Carvedilol was continued throughout the perioperative period. The patient continued to do good throughout hospital stay and was discharged after 7 days. He was followed at 2 weeks interval and 3 months after discharge with no new issues or complaints.

3. Discussion

We have described perioperative management of a pheochromocytoma in a patient with a continuous flow LVAD. There are two common types of LVAD as a mean of mechanical circulatory support, either continuous flow or pulsatile flow. First generation LVADs are pulsatile flow pumps which are smaller compared to the newer generation continuous flow LVADs. The later could be axial flow or centrifugal flow pumps that are more reliable and provide durable support[1].

Two cases have previously described pheochromocytoma presenting with cardiomyopathy requiring LVAD support.[2,3] In prior descriptions, the tumor was removed either during LVAD implantation or after LVAD explant.[4,5]

This case uniquely describes resection of the tumor in a stable LVAD patient.

LVADs provide circulatory support that is essentially nonpulsatile. Continuous flow results in markedly increased sympathetic tone via a baroreceptor-mediated pathway. Pheochromocytoma likewise alters sympathetic tone, and how this interacts with continuous circulatory flow is not known. Of note, the addition of pulsatile via pump speed changes has been shown to reduce sympathetic nerve activity although not back to normal physiologic levels.[6] Current generation centrifugal LVADs do incorporate an artificial “pulse” by transiently decreasing and increased LVAD speed 30 times per minute. The impact of this artificial pulse on sympathetic tone is not known.

4. Conclusion

Traditional assessment of sympathetic tone is challenging in LVAD patients due to the presence of continuous circulatory flow. Invasive management via an arterial line was useful in perioperative management, allowing for accurate circulatory monitoring and hemodynamic control. Finally, close coordination of multiple specialties including advanced heart failure, anesthesia, and endocrinology was vital to the positive outcome in this case.

Declaration of Competing Interest

The others have no conflict of interest.

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