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Treatment of chronic subdural hematoma in a patient with a left ventricular assist device: Case report and review of the literature

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Abstract:

Patients with left ventricular assist devices (LVADs) provide a unique challenge with regard to the management of subdural hematomas (SDH), due to preexisting comorbidities and induced coagulopathy. We report on the case of a 63-year-old female with a preexisting LVAD who developed an acute on chronic SDH with 15 mm of midline shift. She was successfully treated with middle meningeal artery (MMA) embolization and placement of a bedside subdural evacuating port system without hematoma recurrence at 1-year follow-up. Both operative and nonoperative management of SDHs in patients with LVAD is associated with high risk of mortality and morbidity. Chronic SDHs in this patient population can be successfully managed with a minimally invasive approach that includes MMA embolization and bedside subdural drain placement.

Keywords:

Coagulopathy, embolization, left ventricular assist device, middle meningeal artery, subdural hematoma, treatment outcome

Introduction

Left ventricular assist devices (LVADs) provide mechanical circulatory augmentation for patients with advanced heart failure. Intracranial hemorrhage (ICH), including chronic subdural hematomas (cSDH), presents a unique challenge in patients with LVADs.^[1] These patients experience unique challenges when they subsequently need noncardiac surgical procedures or diagnostic imaging as they require constant anticoagulation given high risk of thrombotic events and strict intraoperative LVAD parameters. The current literature provides little insight in how to best manage patients with cSDH with mass effect in this patient population. Given the frailty of this patient population and

associated high morbidity of neurosurgical procedures, durable and minimally invasive treatment options are desired. We present a case of an LVAD patient with a symptomatic cSDH treated successfully with a minimally invasive, multimodal treatment demonstrating excellent outcome at 1-year follow-up. We also review the current literature regarding management of patients with LVADs and ICH.

Case Report

A 63-year-old female with a history of an LVAD (HearMate 2, Abbott, Illinois, US) and warfarin use presented to the emergency room with 5 days of headaches, fatigue, and anorexia. She had no history of trauma, seizures, or alcohol use. Her past medical history was significant for ischemic cardiomyopathy, heart failure, ventricular tachycardia, hypertension,

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type II diabetes, chronic kidney disease, chronic obstructive pulmonary disease, factor VII deficiency, and history of gastrointestinal bleeding, and gout. She had undergone LVAD placement and transcatheter aortic valve replacement for refractory stage D heart failure 5 years before presentation. At the time of LVAD placement, she was placed on warfarin indefinitely to reduce the risk of thrombotic event or failure of the device. On examination, she was alert and oriented to self, place, and time and had mild paresis of the right upper extremity with motor strength of 4/5 and an associated right-sided pronator drift. Laboratory studies were remarkable for international normalized ratio (INR) of 3.1. Computed tomography (CT) of the head revealed left-sided subdural mixed density fluid collection measuring 11 mm at its maximal thickness with associated 15-mm midline shift consistent with acute on cSDH [Figure 1].

The warfarin was stopped, and the warfarin-induced coagulopathy was reversed with phytonadione. Prophylactic levetiracetam was started for seizure prophylaxis, with a plan to discontinue after 1 week in the absence of seizures.

Given the presence of an LVAD and her extensive comorbidities, she was deemed to be at significant operative and general anesthesia risk. Therefore, the planned intervention was a minimally invasive endovascular embolization of the left middle meningeal artery (MMA) followed by placement of a bedside subdural evacuating port system (SEPS) (Medtronic

Inc., Dublin, Ireland) drain. Under general endotracheal anesthesia, embolization of left MMA was performed successfully as noted by satisfactory contrast stasis in the distal MMA vessels presumed to feed the neomembranes in a cSDH [Figure 2]. Immediately after the MMA embolization and under the same setting in the neurointerventional suite, the patient underwent a SEPS placement. A 1-cm incision was planned on the scalp overlying the thickest area of the subdural collection based on localization using the CT scan. A craniostomy was performed using a manual twist drill. Chronic motor-oil-consistency hematoma was evacuated through a durotomy. A left-sided bolt was fastened into the craniostomy site, and tubing was attached to a bulb drain to suction [Figure 3]. Both procedures took a total of 48 min. An immediate XperCT scan (Philips Allura) was completed in the neurointerventional suite confirming evacuation of the hematoma and placement of the SEPS [Figure 1]. She was subsequently extubated and placed in a neurointensive care unit for monitoring. On postoperative day 1, her headaches and mentation significantly improved. A follow-up CT scan of the head that was performed approximately 20 h after the procedure revealed decreased midline shift from 15 mm to 8 mm [Figure 1].

On postoperative day 2, the drain was discontinued after an output of 182 mLs. She was stepped down from the intensive care unit to a floor. She was discharged home on postoperative day 8. She was seen for an outpatient follow-up visit 1 month after her procedure. She noted resolution of headaches, right upper

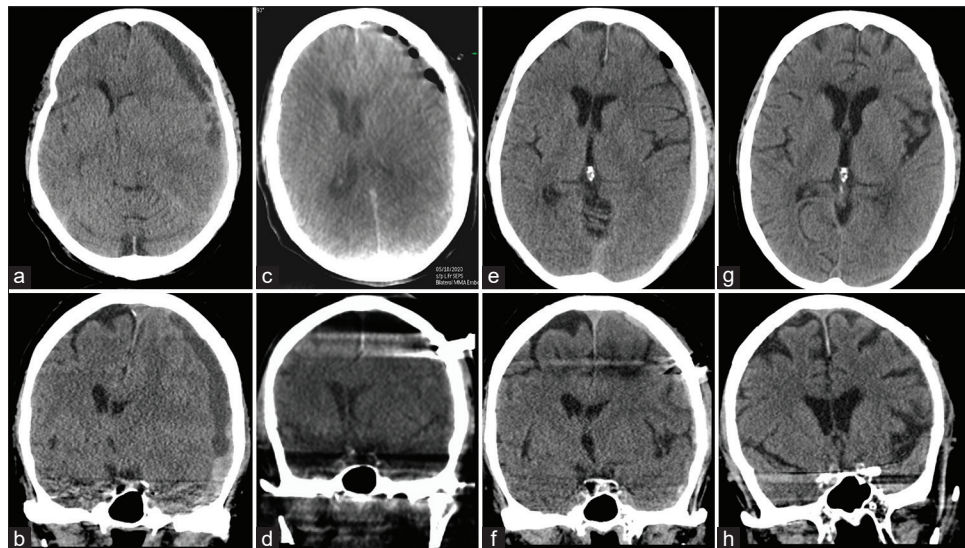


Figure 1: Representative images of computed tomography of the head demonstrating left-sided chronic subdural haematoma with acute component, 11 mm at its maximal thickness and associated 15 mm midline shift in axial (a) and coronal (b) reconstructions prior to the intervention. Axial (c) and coronal (d) reconstructions of the Xper computed tomography head in the interventional radiology suit immediately after the embolization of middle meningeal artery and placement of the subdural evacuating port system drain demonstrating significantly reduced amount of subdural collections and improving midline shift. Axial (e) and coronal (f) reconstructions of the computed tomography head on postintervention day #1 re-demonstrating significantly reduced amount of subdural collections and improving midline shift. Axial (g) and coronal (h) reconstructions of the computed tomography head at 1-month postintervention demonstrating near resolution of the subdural collections and midline shift

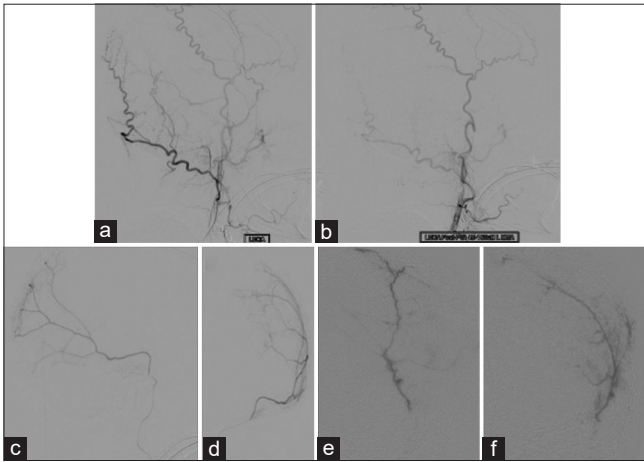


Figure 2: Digital subtraction angiography of the external carotid artery injection in lateral projection prior to (a) and after (b) embolization of the middle meningeal artery branches demonstrating obliteration of distal middle meningeal artery branches presumed to feed the neo-membranes in a chronic subdural hematoma. Selective injections of the parietal branches (c and d) prior to embolization as well as frontal branches (e and f) of middle meningeal artery during embolization in lateral and anteroposterior projections, respectively

extremity paresis, and she was tolerating her activities of daily living at home. CT scan at approximately 1 month after the procedure revealed near resolution of the subdural collections [Figure 1]. Her warfarin was resumed at this time with no evidence of thrombotic or stroke complications during the time she was off of it. Throughout the subsequent year, she had multiple readmissions for medical problems, but she never had a recurrence of the SDH.

Discussion

ICH is the most common cause of death for patients with LVADs.^[2] Overall mortality rate of ICH in patients with LVADs ranges from 48% to 71%.^[2-4] The current literature provides little guidance on how to best manage patients with LVADs who develop symptomatic cSDH. In Mueller^[4] *et al.*'s review of ICH cases in patients with LVAD, four patients had cSDH and were managed nonoperatively. Two of these patients died.^[4] Five of the six operative ICH cases in Wilson *et al.*'s series died. One of those operative cases was a patient with a SDH who had a good outcome. One of the seven nonoperative SDH patients died in 30 days.^[5] In Ibeh *et al.*'s ICH series all four of the SDH patients were managed nonoperatively and had a 6 month mortality rate of 25%.^[6] In Tahir *et al.*, two of the four operative SDH cases (50%) and one of the five nonoperative cases (20%) died.^[7] A meta-analysis by Carroll *et al.* revealed 6 mortalities out of 14 (42.9%) operative cases, and 9 out of 24 (37.5%) nonoperative cases.^[8] A recent case report by Haque *et al.*^[9] reported of a 5-year-old boy with a LVAD who was successfully managed operatively. Initially, the patient was treated conservatively with reversal of the anticoagulation, only



Figure 3: Representative images of the bedside subdural drain placement setup and workflow in the neurointerventional suite (a). Use of the manual twist-drill to perform the craniostomy (b), the evacuating port bolt that is fastened onto the craniostomy site (c), and three-dimensional reconstruction of the computed tomography head demonstrating the evacuating port attached to the skull (d)

to develop worsening of the SDH and required a surgical evacuation.

The mortality rate of patients with LVADs who develop SDH is significantly higher compared to the average population whether or not it is treated operatively or nonoperatively. Complex interplay between factors predisposing to ICH or thrombotic events has been described. The three main factors predisposing a patient to the aforementioned complications are patient-specific medical comorbidities, LVAD device-related factors, and exogenous factors such as anticoagulation management.^[10-12] Significant contribution to the rate of mortality likely stems from the necessity to maintain anticoagulation and the associated risks of worsening or recurrence of SDH. Moreover, in patients with LVAD, INR goal can be as high as 3.5 and often combined with antiplatelet regimen.^[13] The antiplatelet and anticoagulant combination regimen alone can explain the high prevalence and devastating effect of SDHs and ICHs in this patient population. This highlights the need for more effective and minimally invasive interventions for these patients. MMA embolization has proven to be an effective intervention to significantly reduce recurrences of SDH in nonoperative and operative cases.^[14] The efficacy of MMA embolization and how it affects the natural history of cSDHs has been well described in the literature and is beyond the scope of this case report.^[15]

While the medical comorbidities of these patients often render surgery morbid, the severity of the SDH can be life-threatening. The safety and efficacy of the treatment combination of MMA embolization with SEPS placement as a first-line treatment for patients with cSDHs have been reported.^[16] The addition of MMA embolization specifically decreases rates of recurrence

in at-risk population including the elderly and those on anticoagulation or antiplatelet therapy.^[17] As our case demonstrates, the treatment strategy for cSDHs in LVAD patients should be to pursue minimally invasive options while aiming to reduce the risk of recurrence.

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Conflicts of interest

There are no conflicts of interest.

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