



Case report

Multidisciplinary approach to pelvic leiomyomatosis with intracaval and intracardiac extension: A case report and review of the literature

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ABSTRACT

Intravenous leiomyomatosis (IVL) is an uncommon variant of leiomyoma characterized by intravascular proliferation of a histologically benign smooth muscle tumor extending beyond the uterus into the distant great vessels. Leiomyomatosis may reach the inferior vena cava, right atrium, and pulmonary arteries. Owing to its rare occurrence, intracardiac leiomyomatosis has been reported as isolated case reports and small case series. Early diagnosis and prompt surgical intervention are vital to prevent cardiac symptoms, pulmonary embolism, and sudden death. Complete tumor resection is essential for a favorable outcome, usually assisted with multimodal surgical imaging and multidisciplinary surgical planning. Herein, we report the case of a 50-year-old female that presented with a three-month history of abdominal pain and lower extremity edema with evidence of IVL extending to the inferior vena cava and right atrium. The patient was managed with a single-stage surgery involving cardiopulmonary bypass and excision of the right atrial and inferior vena cava tumors, as well as modified radical total abdominal hysterectomy and bilateral salpingo-oophorectomy.

1. Introduction

Intravenous leiomyomatosis (IVL) is an uncommon condition with fewer than 300 cases reported in the peer-reviewed literature (Liu et al., 2020). The first reported case of IVL was by Birch-Hirschfeld in 1896 (Birch-Hirschfeld, 1896). Although IVL arises from benign leiomyomata that arise either from veins within the myometrium or extensive vascular invasion from a myometrial leiomyoma, IVL can lead to various degrees of vascular occlusion and resultant mortality (Norris and Parmley, 1975). Extension into the cardiac chambers may result in sudden death due to heart failure and atrioventricular incarceration (Shi and Shkrum, 2018). The clinical presentation may be extremely variable and requires multiple imaging modalities for complete retroperitoneal and cardiopulmonary evaluation. There is no apparent consensus for the optimal approach to surgical resection, as many reported cases perform either a single- or two-stage surgery for complete resection. We report a patient presenting with advanced disease and extensive intracaval attachment. A multidisciplinary approach was employed in order to effectively perform a single-stage operation utilizing cardiopulmonary

bypass. Additionally, we review the literature and provide an argument for standardized management of this process.

2. Case report

A 50-year-old gravida 6 para 6 woman with uterine leiomyoma presented to the emergency department with a three-month history of abdominal discomfort and bloating accompanied by lower extremity edema. Her medical history was significant only for a recent SARS-CoV-2 (COVID-19) infection without any significant sequelae. Her physical exam and laboratory workup were unremarkable and lower extremity dopplers were negative for an acute deep vein thrombosis. A plain film view of the chest was unremarkable as well. Computed tomography (CT) of the abdomen and pelvis demonstrated a heterogeneously large 20 cm myomatous uterus with evidence of a tumor thrombus extending from a branch of the right internal iliac vein into the right common iliac vein and inferior vena cava (IVC). The tumor thrombus extended cranially to the level of the right atrium with the atrial component measuring 5.4 × 4.4 cm (Fig. 1). An intravenous heparin infusion was initiated, and CT of

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the chest was obtained that re-demonstrated the 5-cm tumor thrombus noted on prior imaging.

A 2-dimensional transthoracic echocardiogram (TTE) revealed a normal ejection fraction (EF), abnormal left ventricular diastolic filling and a mass extending into the right atrium that prolapsed across the tricuspid valve into the right ventricle. The coronary arteries were further studied with CT angiography and were normal and the intra-cardiac mass was found to be obstructing a large portion of the tricuspid valve area. The patient denied any cardiac symptoms or dyspnea.

A multidisciplinary team was assembled that included members from vascular surgery, urology, anesthesiology, cardiothoracic surgery (CTS) and gynecologic oncology (GO) departments. The team discussed and debated several aspects of the perioperative care and after thorough deliberations and in light of the patient's stable cardiac status, decided to proceed with a single surgical approach for complete resection. Temporary bilateral ureteral catheters were placed at the initiation of the procedure by the urology team. A median sternotomy was performed simultaneously by the CTS team along with a midline laparotomy by the GO team. As entry to the chest and vascular access for cardiopulmonary bypass was accomplished, a modified radical hysterectomy requiring extensive pelvic sidewall resection was completed. Continuous transesophageal echocardiographic monitoring was available throughout the hysterectomy to monitor for possible tumor embolism. The tumor was transected at the level of its invasion into the internal iliac vein to facilitate removal of the uterus. Systemic anticoagulation for cardiopulmonary bypass was delayed until after completion of the hysterectomy.

Following completion of the hysterectomy, cardiopulmonary bypass was initiated with arterial perfusion through the ascending aorta and venous return through the superior vena cava and left femoral vein (Fig. 2). A right atriotomy was performed and the intracardiac mass was transected at the level of the orifice of the IVC, allowing the remnant to retract caudally. This facilitated removal of the remainder of the mass through an IVC venotomy (Fig. 3). Suction evacuation of blood during the IVC venotomy returned to the cardiothoracic bypass circuit, effectively maintaining perfusion without blood transfusion. The atriotomy and venotomy were repaired and the patient was separated from bypass without difficulty or transfusion. Total blood loss for the entire operation was 1000 cc. She was restarted on prophylactic anticoagulation and was transfused one unit of packed red blood cells postoperatively. Her postoperative course was significant for superficial thrombophlebitis

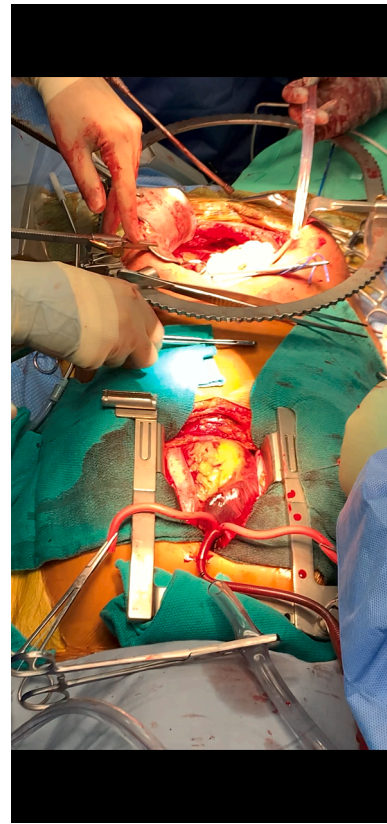


Fig. 2. Multidisciplinary approach to surgery demonstrating cardiopulmonary bypass with arterial perfusion through the ascending aorta and venous return through the superior vena cava and left femoral vein.

diagnosed on CT of the abdomen and pelvis due to pyrexia on post-operative day #8. She was discharged home eleven days after surgery. Pathological evaluation of the specimens confirmed the suspected diagnosis of benign leiomyoma in all excised specimens. She remains without disease recurrence after 16 months.

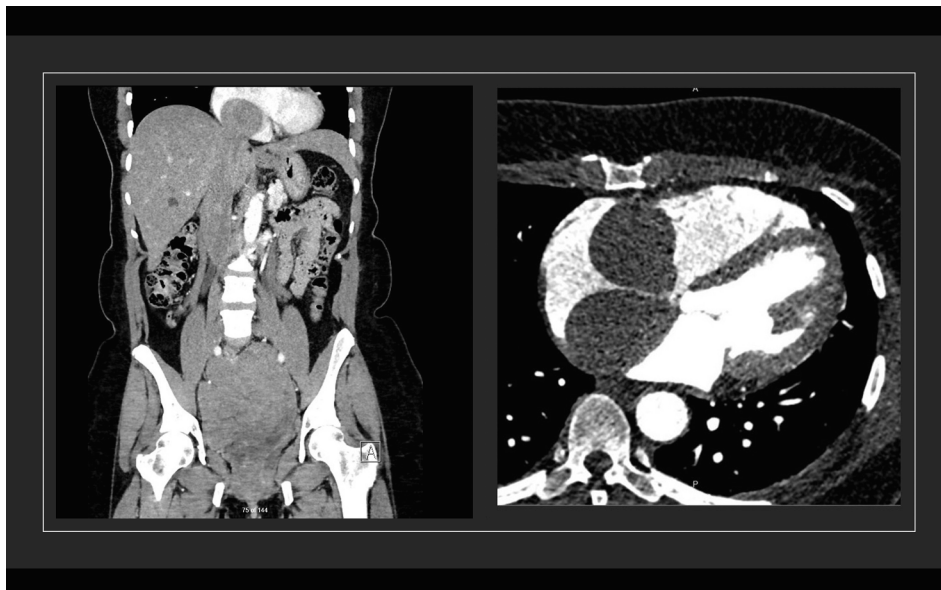


Fig. 1. Coronal and axial computed tomography view of large myomatous uterus in the pelvis with intra-cardiac tumor extension.



Fig. 3. Gross specimens of intra-cardiac and vena cava lesions after extraction.

3. Discussion

IVL is an uncommon condition, usually arising from the uterus and characterized by nodular masses of histologically benign smooth muscle. Although IVL is usually limited to the uterus or parametria, it can extend intravascularly over variable distances and may reach the IVC, right atrium, and pulmonary arteries. The first reported case of intra-cardiac extension of IVL was in 1907 by Durck (1907). The etiology of the disease is explained by two theories: i) direct mural origin from the vein walls (Norris and Parmley, 1975), and ii) pelvic sidewall vascular invasion by a primary uterine leiomyoma (Borland and Wotring, 1964). Due to its rarity, it may be misdiagnosed pre-operatively leading to inappropriate treatment, especially in cases of patients with a history of prior hysterectomy (Xu et al., 2013). To date, less than 300 cases have been reported, and there are fewer than 100 cases with cardiac involvement in the peer-reviewed literature (Xu et al., 2013).

IVL most commonly affects women in the fifth decade, however the age of affected patients varies from 24 to 76 years (Xu et al., 2013). The clinical manifestations are closely related to the extent of involvement. Signs and symptoms include: i) pelvic pain, abnormal uterine bleeding due to myomatous uterus; ii) lower extremity edema from IVC occlusion; iii) dyspnea and chest pain caused by pulmonary embolus; iv) syncopal episodes due to tricuspid orifice obstruction from the tumor; v) ECG abnormalities related to enlargement of the cardiac chambers, systolic dysfunction, and cardiac valve involvement; and vi) sudden death from obstruction of the tricuspid valve orifice or right ventricular outflow tract (Fornaris et al., 2015).

Pre-operative imaging modalities can be useful for surgical planning to delineate the extent of the disease and may provide accurate information on tumor relationship with surrounding structures. Echocardiography, venography, and CT of the abdomen and pelvis, along with other imaging modalities such as magnetic resonance venography or CT angiography (CTA) should be performed preoperatively. In this case, precise preoperative planning was supported by CTA and echocardiography (ECHO). In our case, the patient presented with mild abdominal discomfort, bloating and lower extremity edema, and the initial echocardiogram demonstrated mild tricuspid regurgitation. Aside from CT, ECHO is frequently the first to identify the intracardiac mass with a non-specific appearance that could mimic a thrombus or a primary cardiac tumor.

There are two pathways by which the disease propagates

intravenously which are described by Lam et al. (2004). The first method involves invasion of an ovarian vein with extension into the infra-diaphragmatic segment of the IVC, bypassing the iliac veins. The second method is via the parametrial uterine veins, with progressive extension to the IVC via the internal and common iliac veins (Lam et al., 2004). Resultant intra-cardiac propagation of the tumor may result in an atrial destination (45.6% of cases), right ventricle (45.6%), or the pulmonary vasculature (8.8%) (Lam et al., 2004).

Successful management of this disease revolves entirely around surgical extirpation. This is facilitated by a combined multidisciplinary thoraco-abdominal approach with simultaneous excision of intracardiac and IVC tumors, as well as total abdominal hysterectomy and BSO. Incomplete excision will result in recurrences that require additional surgery or may lead to death. To reduce recurrences, most scholars recommend total hysterectomy and bilateral oophorectomy together with pelvic leiomyoma excision. Whether ovarian preservation is a risk factor for disease recurrence remains a topic of debate; however, given that intravenous leiomyomatosis is associated with high estrogen expression, intuitively one would consider that ovarian preservation is not recommended. Ariza et al. (1982) reported the first total resection, during which a delayed laparotomy after resection of the intracardiac portion of the tumor was performed. Surgical approaches reported in the literature have included either a two-stage surgery, involving resection of the abdominopelvic and intrathoracic components in two separate operations, or, more recently, a single-stage operation using normothermic CPB and total tumor extirpation. Tricuspid valve replacement, annuloplasty, and aortocoronary bypass grafting may also be performed if indicated (Stegmann et al., 1987; Cooper et al., 1992; Tierney et al., 1980).

Wang et al. (2012) found that compared with single-stage surgery, the two-stage surgery had a longer overall operative time, a larger amount of total blood loss, higher rates of transfusion, higher risk of tumor recurrence, and a longer hospital stay. In general, single-stage surgery is preferred, with a multidisciplinary team including gynecologic oncologists, anesthesiologists, intensive care specialists, and thoracic surgeons at a tertiary center capable of the required intra-operative monitoring. Rates of complete removal are reported in 54% of patients and a rate of intra-operative mortality of 1.5% (Cooper et al., 1992; Tierney et al., 1980; Gan et al., 2011). The ideal procedure is based on the individual patient and her presentation. Our patient underwent a single-stage CPB with resection of the right atrial mass and

IVC along with a radical abdominal hysterectomy and BSO with extensive pelvic sidewall resection. This proved to be vital as the mass could neither be wholly extracted from the right atrium, nor from the IVC alone. It required transection at the level of the IVC orifice, to facilitate simultaneous removal from the right atrium and the IVC. Importantly, cardiopulmonary bypass allowed resection of tumor from the atrium and vena cava without intraoperative exogenous blood transfusion.

4. Conclusions

Intravenous leiomyomatosis with intracardiac involvement is uncommon and occurs sporadically most often among women in their fifth decade of life. This condition has variable presentation, with a wide differential diagnosis based on presenting symptoms. A single-stage operative approach using a multidisciplinary team is preferred for complete resection in proper surgical candidates. The decision to stage procedures should be determined by the patient's stability, physiologic reserve, and the complexity of the pelvic component. Cardiopulmonary bypass can help to avoid massive transfusion requirements, organ dysfunction, neurologic deficits, and severe coagulopathy. The true rate of recurrence for completely resected disease is unknown, but regrowth has been reported in as many as 30% of patients (Cooper et al., 1992; Gan et al., 2011). This is thought to be due to incomplete resection or the presence of microscopic metastasis. The most common site of subsequent spread is to the lung (Tierney et al., 1980). Therefore, post-operative follow-up imaging at routine intervals is recommended.

5. Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author Contribution

NG and MM were primarily responsible for drafting the manuscript. Reviews were equally performed by CF, KK, TK, DV, and RH. All authors were involved in reviewing the paper prior to submission.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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