

# Benefits of Laparoscopic Surgery for Bleeding Events in Patients with Implantable Left Ventricular Assist Devices during Antithrombotic Therapy

Aya Nakae<sup>1</sup>, Michiko Kodama<sup>1\*</sup>, Eiji Kobayashi<sup>1</sup>, Kae Hashimoto<sup>1</sup>, Yuji Tominaga<sup>2</sup>, Tadashi Kimura<sup>1</sup>

Departments of <sup>1</sup>Obstetrics and Gynecology and <sup>2</sup>Cardiovascular Surgery, Osaka University Graduate School of Medicine, Suita, Osaka, Japan

## Abstract

Hemorrhagic ovarian cysts (HOCs), a common gynecological disease causing intraabdominal bleeding, can be life threatening in patients undergoing antithrombotic therapy, especially those with left ventricular assist device (LVAD) implantation under strong antithrombotic therapy. We encountered three postLVAD implantation cases with intraabdominal bleeding due to suspected HOCs, which required surgery for hemostasis. Such patients are not only at a higher risk of bleeding but also have restrictions in available surgical incision sites to avoid damaging the LVAD driveline located underneath the abdominal wall. Laparoscopic surgery, which can be performed through minute incisions with flexible site selection, may benefit intraabdominal hemorrhage patients with LVADs.

**Keywords:** Hemorrhagic ovarian cysts, laparoscopic surgery, left ventricular assist device

## INTRODUCTION

Hemorrhagic ovarian cysts (HOCs) are common diseases in women of reproductive age because functional cysts, including follicular or corpus luteal cysts, are physiologic phenomena associated with ovulation.<sup>[1]</sup> Although most HOCs can be managed conservatively, intratumor hemorrhage is easily exacerbated and its rupture leads to massive hemoperitoneum and life-threatening conditions in patients undergoing anticoagulation therapy.<sup>[2]</sup>

Left ventricular assist devices (LVADs) provide mechanical support for left ventricular ejection in patients with heart failure [Figure 1]. The LVAD, originally developed as a bridge therapy for patients awaiting heart transplantation, has been commonly used as a destination therapy in noncandidates for transplantation.<sup>[3]</sup> The antithrombotic treatment intensity is stronger in patients with LVAD implantation than that in patients with other diseases being prone to thrombotic events.<sup>[4]</sup>

Hence, the incidence of HOCs in patients wearing LVAD may be increased; however, there was no literature describing intraabdominal bleeding due to HOCs in LVAD patients. We report three cases requiring surgeries for bleeding events due to suspected HOCs, in postLVAD implantation patients.

## CASE REPORTS

All patients underwent Heartmate II<sup>TM</sup> (Thoratec, Pleasanton, CA, USA) LVAD implantation and were treated with chronic anticoagulant therapy, warfarin potassium, and aspirin. All patients provided written informed consent. The clinical courses of each case are summarized in Table 1.

### Case 1

A 35-year-old woman visited the emergency room for nausea and pain. Blood testing revealed a hemoglobin level

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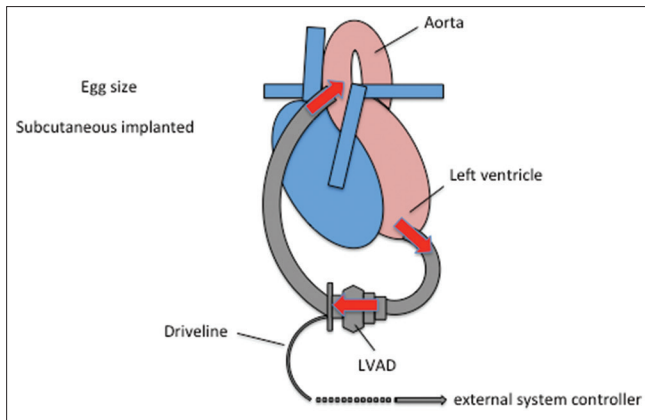
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**Address for correspondence:** Dr. Michiko Kodama,  
Department of Obstetrics and Gynecology, Osaka University Graduate  
School of Medicine, 2-2 Yamadaoka, Suita, Osaka 565-0871, Japan.  
E-mail: mkodama@gyne.med.osaka-u.ac.jp

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**Figure 1:** Components of one of the left ventricular assist device Heartmate IITM (Throated, Pleasanton, CA, USA). The implanted pump draws blood from the apex of the left ventricle and delivers it to the ascending aorta. The pump is electrically driven by means of a percutaneous lead that connects the pump to an external system controller and power source

of 4.6 g/dL. Computed tomography (CT) revealed massive intraabdominal bleeding. Transvaginal ultrasound showed a hyperechogenic lesion around the right ovary and a large anechoic fluid in the abdominal cavity. Considering these findings and her last menstrual cycle, ruptured HOC at luteal phase was suspected. Emergent open surgery was considered due to the hemodynamic instability and the lack of experience of emergent laparoscopic surgery for such cases. A Pfannenstiel incision was chosen because a midline incision might damage the driveline component of the LVAD device, located 3 cm below her navel. Right salpingo-oophorectomy (SO) for ruptured HOC was performed. On the 1<sup>st</sup> day after surgery, the hemoglobin level improved to 10.2 g/dL and prothrombin time-international normalized ratio (PT-INR) was maintained at 2.3–2.4 after restarting warfarin. Persistent bleeding and hematoma formation around the incision required it to be compressed for two additional postoperative days.

**Case 2**

A 57-year-old woman complained of extreme abdominal pain lasting 4 days during hospitalization for the treatment of infective endocarditis of an aortic valve closure patch. C-reactive protein increased from 1.6 to 8.1 mg/dL over 5 days irrespective of administrating daptomycin 525 mg daily. Pelvic examination revealed a soft mass in the Douglas pouch, and transvaginal ultrasonography showed a heterogeneous cyst, 89 mm × 81 mm in size, located on the left pelvis without ascites, suggesting left HOC. CT revealed the mass increasing in size from 6 cm to 9 cm over 4 days. After switching warfarin to heparin 48 h before surgery, scheduled laparoscopic surgery was performed. Extensive adhesions between the ascending colon and the peritoneum, and the sigmoid colon and left ovarian cyst, were removed by Harmonic Ace Ultrasonic

**Table 1: A summary of the 3 cases**

	Age (Year)	Types of cardiomyopathy	Symptoms	Antithrombotic therapy
Case1	35	Dilated cardiomyopathy	Nausea, abdominal/epigastric pain	4.5 mg warfarin potassium 100 mg aspirin daily
Case2	57	Dilated cardiomyopathy	Abdominal pain	5.25 mg warfarin potassium 100 mg aspirin daily
Case3	48	Hypertrophic cardiomyopathy	Abdominal distension	2.5 mg warfarin potassium 100 mg aspirin daily

	Preoperative Hb level (g/dl)	Warfarin reversal	PT-INR (pre/post reversal)	Surgery type
Case1	4.6	Prothrombin complex concentrate 25u/kg	2.4/1.88	Laparotomy
Case2	8.8	-	2.2/-	Laparoscopic surgery
Case3	8.2	Prothrombin complex concentrate 25u/kg	3.2/1.56	Laparoscopic surgery

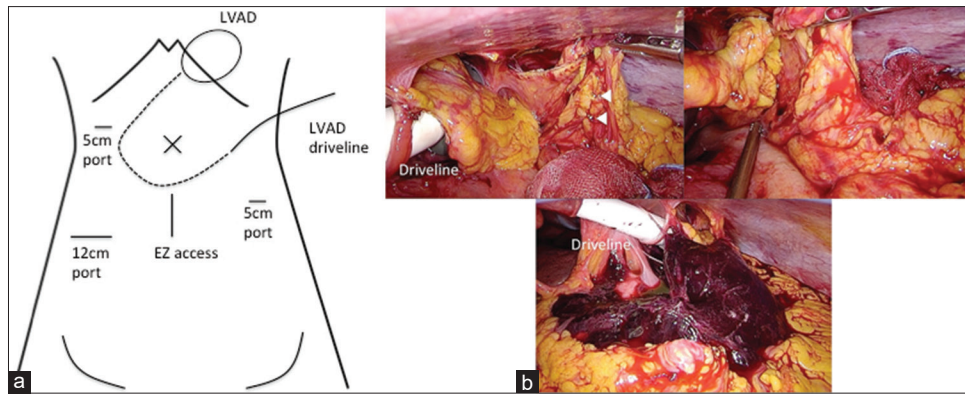
	Blood loss (ml)	RBC transfusion	Causes of hemorrhage
Case1	2970	4 unit	Corpus luteal hemorrhage of the right ovary
Case2	430	4 unit	Intratumor bleeding of the left endometriotic cyst
Case3	1530	4 unit	Damage of the gastropiploic artery

Abbreviation, Hb; hemoglobin, PT-INR; prothrombin time-international normalized ratio RBC; red blood cell

Shears (Johnson and Johnson, New Brunswick, NJ, USA). Left SO for ruptured endometriotic cyst detected in the Douglas pouch was successfully performed. Although hemostasis was achieved even after restarting warfarin, prolonged bacteremia associated with infective endocarditis required antibiotics for 2 more months postoperative.

**Case 3**

A 48-year-old woman had notable abdominal distension and pain for 3 days, despite LVAD driveline infection being cured by debridement and antibiotics 3 weeks ago. Transvaginal ultrasound revealed a heterogeneous fluid in the Douglas and vesicouterine pouches, sparing the Morison pouch, with normal-sized ovaries. The bleeding was suspected to be ovarian in source because the fluid was limited to the pelvis. Emergent exploratory laparoscopic examination was initiated by gynecological and gastroenterological surgeons through



**Figure 2:** (a) Diagram of port placement and the left ventricular assist device's driveline location in Case 3. To avoid damaging the left ventricular assist device driveline, precise locations for four small incisions were determined. (b) The upper left: The bleeding point was clipped successfully to achieve hemostasis. The two white triangles show the clipped sites. The upper right: A bleeding point was identified in the gastroepiploic artery. Below: Inside the abdominal cavity, a large hematoma is noted with expansion over the greater omentum of the right upper abdomen

navel incision. Gynecological organs were normal, but a large hematoma was noted with spread to the greater omentum of the right upper abdomen. Hence, three other ports were inserted at suitable sites for epigastric surgery [Figure 2a]. The surgery revealed the driveline strayed into the abdominal cavity damaged the gastroepiploic artery. Hemostasis was achieved by clipping the bleeding point [Figure 2b]. The postoperative course was uneventful.

## DISCUSSION

HOCs can be life threatening for patients affected with thrombotic disorders as venous thromboembolism, atrial fibrillation, recurrent thrombotic episodes, and postmechanical heart valve replacement.<sup>[5]</sup> Antithrombotic agents were administered for such thrombotic disorders, for maintaining the PT-INR levels between 2.0 and 3.0.<sup>[6]</sup> On the other hand, depending on the LVAD device used, PT-INR level should be maintained at 2.5–3.5 in LVAD patients.<sup>[4]</sup> Further considering that platelets and coagulation factors in LVAD patients are reduced due to existing cardiogenic congestive hepatopathy, female of reproductive age with LVAD implantation might be theoretically at a higher risk for HOC.

Although some of the cases were treated with strong anticoagulant therapy, a multidisciplinary team including gynecologists, cardiologists, surgeons, and anesthesiologists opted for surgical management for our cases considering the following: A low possibility of spontaneous hemostasis in observational management; an increased need for blood transfusions, which may be harmful for cardiac function in an already cardiologically impaired patient. According to the American College of Cardiology guidelines for antithrombotic management in noncardiac surgery, the prevention of thromboembolic events is more important than that of bleeding complications.<sup>[7]</sup> Antiplatelet therapy should not be discontinued before elective surgery or procedure unless the

surgical bleeding risk is high.<sup>[8]</sup> To avoid thrombosis, leading to potential mechanical breakdown of the LVAD, antiplatelet therapy was continued perioperatively in the planned surgery as Case 2.

Laparoscopic surgery may be superior to laparotomy in patients with LVAD implantation, as smaller incisions can minimize the chance of postoperative bleeding. Indeed, our laparotomy case developed postoperative hematoma around the incision but not in the laparoscopic cases. Furthermore, a laparoscopic approach provides the flexibility of choice for making incision sites, which not only avoids damage to the LVAD driveline but is also more ideal in managing bleeding of unknown origin, such as in Case 3. Previously, laparoscopic surgery in LVAD patients with pneumoperitoneum was reported to be safely performed without any problems.<sup>[9]</sup> As a caveat, there are potential issues that should be noted in laparoscopic surgery for LVAD patients, mainly that Trendelenburg position increases right heart preload and that pneumoperitoneum could increase the intrapleural pressure, causing a right heart afterload increase.<sup>[10]</sup> Hemodynamic changes caused by blood loss in massive intraabdominal bleeding must also be considered. Hence, it is extremely important to manage anesthesia with careful attention to LVAD flow, circulatory dynamics, and ventilation conditions.

## CONCLUSION

Laparoscopic surgery in patients with LVAD implantation may be superior to laparotomy on the aspect of low risk for postoperative hematoma and flexibility in determining the incision sites.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be

reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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