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CASE REPORT

Feasibility and safety of laparoscopic colorectal surgeries for patients with left ventricular assist device

Fawaz Abo-Alhassan[1] · Bertrand Trilling[1,2] · Pierre-Yves Sage[1] · Edouard Girard[1,2] · Jean-Luc Faucheron[1,2]

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Abstract

Purpose There is limited literature regarding the feasibility and safety of laparoscopic procedures in patients having mechanical circulatory support, especially colonic resections.

Methods The aim of this study is to present the case of a laparoscopic colectomy for cancer undergone in a 69-year-old patient having a HeartWare II at our institution without any postoperative major complications and to describe the perioperative management and outcome of these patients according to the literature, regarding the hemodynamic, hemorrhagic, and infectious risks and the safety of this procedure.

Results There was no 90-day postoperative morbidity or death. A total of six patients including ours were identified in the study. This study has a limited number of patients and relatively short follow-up time.

Conclusion Even though the management of patients having a LVAD is challenging and needs a multidisciplinary approach, reported literatures have shown the safety and feasibility of laparoscopic interventions for colorectal surgeries.

Keywords Laparoscopic colectomy · Mechanical circulatory support · Morbidity

Introduction

Heart failure is a syndromic condition that is highly prevalent especially with the increasing life expectancy worldwide. It has been estimated to occur in 10 to 20% of the population aged over 75 years [1]. Even though medical treatment is the initial approach for patients with heart failure, those being refractory remain a therapeutic challenge, and could be indicated for cardiac transplantation [2]. Due to long waiting lists of cardiac transplantation and shortage of donors for patients who have refractory end-stage heart failure, more left ventricular assist devices (LVAD) are being placed as a temporary solution before transplantation or even as a definitive therapy for those that are not candidates for transplantation. With the development and improvement of the LVADs, the morbidity and mortality rates are declining and life expectancies increasing [2]. Therefore, there are an increasing number of patients with mechanical circulatory support presenting with non-cardiac surgical diseases needing surgical treatment [3].

There is a growing interest generally in minimal invasive surgery due to their reduced postoperative complications, sometimes being the gold standard surgical approach for colorectal surgeries. Nevertheless, certain pathophysiological modifications at the cardiopulmonary levels caused by the pneumoperitoneum and the drug-induced vasodilatation could have an important impact in patients with mechanical circulatory support. Certain LVAD are preload dependent, and abdominal insufflation could significantly impact cardiac venous return [4]. Therefore, the anesthetic management of patients having LVAD could be challenging. Great caution should be taken for ports placement and incision for specimen extraction because of the risk of damaging stimulator and electrodes of the device that are often inserted under the abdominal skin and cross the abdominal cavity. Last, as with any patients with indwelling vascular devices at the time of surgery, infection should be a concern. This is particularly true in the case of LVAD and colonic resection, where infection represents a leading source of rehospitalization and adverse outcomes [5, 6].

✉ Jean-Luc Faucheron
JLFaucheron@chu-grenoble.fr

[1] Department of Colorectal Surgery, Grenoble Alps University Hospital, 38000 Grenoble, France

[2] University Grenoble Alpes, CNRS, Grenoble INP, TIMC-IMAG, 38000 Grenoble, France

There is limited literature regarding the feasibility and safety of laparoscopic procedures in patients having mechanical circulatory support, especially for colorectal procedures.

The aim of this study is to present the case of laparoscopic right hemicolectomy undergone in a patient having a HeartWare II at our institution without any postoperative major complications and to describe the perioperative management of these patients according to the literature, regarding the hemodynamics, hemorrhagic, and infectious risks and the safety of this procedure. It also adds to the existing literature which suggests the feasibility and safety of laparoscopic surgeries for non-cardiac causes for patients with LVADs.

Materials and methods

Patients

We present the case of a patient who had a LVAD (HeartWare II) placement for ischemic heart failure as a definitive therapy and underwent a laparoscopic right hemicolectomy for adenocarcinoma. She gave her informed consent for publication. We also reviewed the published cases of laparoscopic colectomy in such a condition.

Methods

A systematic review of the English and French literature was performed by searching the major electronic databases including MEDLINE, Pubmed, and Embase, using the keywords "left ventricular assist device," "colonic adenocarcinoma," "colitis," "diverticulitis," and "laparoscopic colectomy." All relevant references were reviewed for possible inclusion. All references of the relevant articles were screened for any further articles that were not identified in the initial search.

Results

Case presentation

A 69-year-old woman had undergone a LVAD (HeartWare II) placement for ischemic heart failure as a definitive therapy. The cardiologic postoperative period was marked by gastrointestinal bleeding 2 years and 2 months following the device implant. A full colonoscopy was performed that showed a bleeding ulcerative lesion in the ascending colon. Biopsies confirmed the diagnosis of moderately differentiated adenocarcinoma. A thoracic and abdominopelvic CT scan showed no secondary metastatic lesion.

After discussion in our multidisciplinary oncological board, and especially with the cardiologists and anesthesiologists, a laparoscopic curative right hemicolectomy was proposed to the patient. She was maintained on her antiplatelets regimen and underwent bridging with full-dose low molecular weight heparin for the procedure.

The intervention was performed by an experienced laparoscopic surgeon. The patient was asked to perform "modern fasting" which includes a normal meal the previous evening, followed by oral intake of a 600-mL carbohydrate-loaded drink until 2 h before surgery. The patient underwent general endotracheal anesthesia and did not require invasive hemodynamic monitoring or intraoperative inotropic support. Antibiotic prophylaxis with cefoxitin 2 g was administered at induction of anesthesia. The patient was placed on the operating table with both thighs at the same level as the abdomen to enhance maneuverability of the laparoscopic instruments. A urinary catheter was inserted and kept for 2 days.

The first 10-mm balloon port was placed in the umbilicus under direct vision for the 0° laparoscope and a pneumoperitoneum was created. Three additional laparoscopic ports were placed taking care of intra-abdominal device's cannulas and cables. A 12-mm port was placed in the left hypochondrial space and two 5-mm ports in the left and right iliac fossa. Abdominal insufflation was kept to a minimum, around 10 mmHg, during most of the procedure in order to maintain an adequate cardiac preload. No Trendelenbourg position was used during the procedure. However, slight left lateral position was needed to have better visualization of the operative field. The abdominal cavity was inspected to confirm the diagnosis and rule out unexpected difficulties. A lateral to medial dissection was used in this patient. The right colic artery and ileocolic artery were identified close to the superior mesenteric artery and transected once squeletonized with an electrothermal bipolar vessel sealer. Complete mobilization of the right colon was performed that was exteriorized through a medial, supraombilical incision without sectioning the rectus abdominis muscles. An extracorporeal right colectomy and side-to-side ileocolic anastomosis using a linear stapler were performed. The procedure was uneventful, and therefore, no drain was left behind.

Postoperatively, the patient remained in the intensive care unit for 2 days and was transferred later to the cardiology department for the postoperative phase. Curative anticoagulation was restarted on postoperative day 1. The patient was discharged on postoperative day 13, with an uneventful postoperative course. She needed no adjuvant oncological therapy as the pathology report classified the lesion as pT3N0M0R0.

Case series

From the first article in 2009 up until the present, 4 articles reporting 5 patients with LVAD who underwent laparoscopic colectomy were identified and included in this review [7–10]. All these patients had a laparoscopic right colectomy (Table 1).

Table 1 Reported cases of laparoscopic right colectomy in patients with LVAD support

No.	Author	Age	Sex	Type of LVAD	Cardiologic aim	Etiology	90-Day postoperative course
1	Livi[10]	48	m	Novacor	Bridge therapy	Adenocarcinoma	Uneventful
2	Stewart[11]	66	m	Heartmate II	Definitive therapy	Adenocarcinoma	Uneventful
3	Stewart[11]	50	m	Heartmate II	Bridge therapy	Vascular lesion	Uneventful
4	Sathishkumar[12]	56	m	Heartmate II	Bridge therapy	Adenocarcinoma	Uneventful
5	Ahmed[13]	77	m	Heartmate XVE	Definitive therapy	Adenocarcinoma	Uneventful*

*This patient died from heart failure at 2.4 years following right colectomy

Discussion

Advances in therapy for patients with advanced heart failure who have mechanical circulatory support have led to more patients presenting with non-cardiac surgical diseases needing surgical procedures [3]. Certain precautions need to be taken into consideration to improve surgical outcome.

The placement of these LVADs in the upper abdominal and thoracic region taking in consideration the intracorporeal and extracorporeal connections needs careful analysis and modification of operative strategy for both the surgeon and anesthesiologist. A multidisciplinary approach to these patients is crucial to insure maximal safety and reduce postoperative morbidity and mortality. Clinicians who are unfamiliar with these devices and that are faced with patients carrying them often perceive them as patients still having advanced heart failure and manage these patients just as they manage patients with NYHA class IV. However, now that they are being supported by LVADs, patients present with a better physiological condition. Therefore, their management is not as patients with advanced heart failure, but still should be taken with many precautions [3].

Positioning of the patient intraoperatively should be done with caution taking in mind that in a Trendelenburg position, venous return increases, while in reverse Trendelenburg position, venous return and cardiac preload reduce, lowering eventually the cardiac output and blood pressure [9]. The LVAD's pumping mechanism depends on both preload and afterload, meaning that inadequate filling leads to inadequate flow and reduced end-organ perfusion. As these devices do not obey the Starling's law with respect to cardiac output and end diastolic volume, any factor that decreases cardiac preload, such as drug-induced venodilatation, dehydration, patient's position, or hemorrhage, could decrease pump flow or cardiac output [3]. Peritoneal insufflation should be kept to a minimum and only increased in a gradual fashion. This is because the insufflation has detrimental effects on cardiac preload, while at the same time increasing the afterload [9].

An anesthesiologist experienced with VADs should be present during the intervention for optimal management of the perioperative period. Hemodynamic disturbances can be rapid with these devices especially since most are preload dependent. So failure to compensate the reduction in cardiac preload due to positioning, intraperitoneal insufflation, or even anesthetic drug-induced vasodilatation could easily lead to hemodynamic instability. Also, reduction in cardiac afterload may lead to a suctioning effect leading to left ventricular collapse, therefore bowing of left ventricular septum, which eventually risks an acute right heart failure [4]. This can be seen by a rise in central venous pressure and a reduction in mean arterial pressure, which necessitates at times a direct alpha agonist to reverse these changes and increase cardiac afterload. Therefore, the need for trans-esophageal ultrasound monitoring of cardiac output during the procedure with an anesthesiologist familiar with it is highly crucial. Some series claimed operating all their patients in cardiac operating theaters, with even the presence of a cardiac surgeon, and postoperative care performed in cardiac intensive care units [11].

As newer generations of LVADs function with continuous blood flow, pulse oxymetry, and non-invasive blood pressure values cannot be reliable means of surveillance. Serial blood gas measurements should be done as abnormalities could indicate decreased end-organ perfusion [3]. Cerebral tissue oxygenation monitoring with a cerebral oxymetry is another reliable and successful mean of monitoring tissue perfusion, as it provides real-time data unlike serial blood gas measurements [12].

The non-pulsatile flow of most second and third generation LVADs necessitates less anticoagulation due to some evidence suggesting an acquired von-Willebrand syndrome, arteriovenous malformations, and platelet dysfunction, in a mechanism still not completely understood. This hypocoagulable state not only makes these LVADs need less anticoagulation but also withholding anticoagulation perioperatively risks lower thromboembolic complications [13]. In fact, during the immediate postoperative period with patients having the continuous flow LVADs, the risk is more in favor of bleeding than thromboembolic events. Therefore, anticoagulation could safely be withheld during the first 24 h, with most series claiming no thromboembolic complications [10, 13]. Other reports have claimed transiting directly to oral anticoagulants without any additional risk of thromboembolism [14]. However, in case of complication needing additional procedure such as drainage or surgical intervention, anticoagulation reversal could be challenging.

Although there is no evidence that these patients with implantable LVADs have increased risk of postoperative infections including endocarditis, the onset of infection could be life-threatening. As there are no specific guidelines for prophylactic antibiotic with patients carrying LVADs, most reported cases follow the preoperative antibiotic prophylaxis according to WHO guidelines. However, it was noted that some have continued antibiotics for several days postoperatively, especially when postoperative infectious risk was high [5, 15]. One case series reported laparoscopic abdominal interventions of which one underwent a sleeve gastrectomy for morbid obesity. While waiting for his cardiac transplant, his candidacy for transplant was only validated after sufficient weight loss [10]. As with the 50-year-old patient in this series [8], he required an exploratory laparoscopy for gastrointestinal bleeding. The two patients had their unremarkable intraoperative and postoperative courses.

This review has a limited number of patients with LVAD support who underwent colorectal resection and relatively short follow-up time.

Conclusion

Even though the management of patients having a LVAD is challenging and needs a multidisciplinary approach, reported literature has shown the safety and feasibility of laparoscopic interventions for non-cardiac surgeries. As more and more LVADs are being implanted, with newer generations being more developed, surgeons and anesthesiologists in all specialties should be aware of these devices as they could be confronted 1 day with a patient carrying them. With proper appropriate planning, a broad range of surgeries can be safely undergone, particularly colorectal surgeries.

Compliance with ethical standards

Conflict of interest Jean-Luc Faucheron has a consulting agreement with AMI, Covidien, Medtronic, Ethicon, MSD, Legrand, and Johnson & Johnson Beauté Santé France. This has had no impact with the results of this study. Fawaz Abo Alhassan, Bertrand Trilling, Pierre-Yves Sage, and Edouard Girard have no conflicts of interest or financial ties to disclose.

Ethical approval The study has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed consent For this type of study, formal consent is not required, except for the patient from our department who gave her formal written consent for publication.

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