CASE REPORT

UDC: 616.12-08-06:616.345-005.1
DOI: https://doi.org/10.2298/VSP190815116R

Early massive gastrointestinal bleeding as a complication of left ventricular assist device implantation

Rano masivno gastrointestinalno krvarenje kao komplikacija ugradnje uređaja za mehaničku potporu rada leve komore

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Abstract

Introduction. Implantation of left ventricular assist device (LVAD) improves survival and quality of life in patients with end-stage heart failure. We reported a case of a severe gastrointestinal bleeding as a life threatening complication in early recovering postoperative period of continuous blood flow LVAD implantation. **Case report.** The patient had a history of heart failure due to ischemic cardiomyopathy with low systolic function, as an indication for LVAD implantation. The operation and the postoperative course were uneventful. On the 17th postoperative day, the patient developed severe anemia, which was followed by melena with blood clots. Endoscopic examinations revealed diffuse colonic bleeding. Oral anticoagulation therapy was discontinued, and fresh frozen plasma, K vitamin substitution, and human prothrombin complex were administered. The LVAD speed was reduced and subcutaneous administration of somatostatin analog octreotide was initiated. These measures successfully stopped the bleeding and the patient was stabilized. Due to a multidisciplinary team approach, the bleeding was successfully managed and the patient recovered. **Conclusion.** Acute gastrointestinal bleeding represents a serious, life-threatening condition that can develop after LVAD implantation, but with timely and appropriate measurements, it can be successfully treated.

Key words:
gastrointestinal hemorrhage; heart assist devices; heart failure; postoperative period; treatment outcome.

Apstrakt

Uvod. Implantacija pumpe za mehaničku potporu rada leve komore (LVAD) poboljšava preživljavanje i kvalitet života bolesnika sa terminalnom srčanom slabošću. Prikazan je slučaj teškog gastrointestinalnog krvarenja kao životnougrožavajuće komplikacije u ranom postoperativnom periodu nakon ugradnje LVAD uređaja sa kontinuiranim protokom krvi. **Prikaz bolesnika.** Dugogodišnjem bolesniku sa srčanom slabošću na terenu ishemijske kardiomiopatije sa sniženom sistolnom funkcijom, bila je indikovana ugradnja LVAD uređaja. Operacija i postoperativni tok su protekli uredno. Sedamnaestog postoperativnog dana došlo je do pojave teške anemije, koja je bila praćena pojavom melene sa prisutnim krvnim ugruščima. Endoskopskim pregledima otkriveno je difuzno gastrointestinalno krvarenje, pretežno iz debelog creva. Odmah je obustavljena oralna antikoagulantna terapija i primenjeni su sveže smrznuta plazma, supstitucija K vitamina i humani protrombinski kompleks. Brzina LVAD pumpe je smanjena i započeta je primena somatostatinskog analoga oktreotida. Preduzete mere dovele su do prestanka krvarenja i stabilizacije bolesnika. Zahvaljujući saradnji multidisciplinarnog tima krvarenje je uspešno zbrinuto i bolesnik se oporavio. **Zaključak.** Akutno gastrointestinalno krvarenje predstavlja ozbiljno, životno-ugrožavajuće stanje koje se može javiti nakon ugradnje LVAD uređaja, ali uz pravovremene i adekvatne mere može se uspešno izlečiti.

Ključne reči:
krvarenje, gastrointestinalno; srce, implantabilni mehanički aparati; srce, insuficijencija; postoperativni period; lečenje, ishod.

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Introduction

Left ventricular assist device (LVAD) implantation is one of the recommended treatment modalities used for end-stage heart failure. New generation continuous blood flow LVADs have improved durability and better survival for patients, but at the same time they are associated with an increased risk of gastrointestinal (GI) bleeding and other specific complications [1, 2].

In this article, we report a case of a severe life threatening GI bleeding, developed as an early complication of continuous blood flow LVAD implantation.

Case report

A sixty-year-old male patient was admitted for the management of chronic end-stage heart failure with the implantation of LVAD. The patient had a history of coronary artery disease and was first diagnosed seven years ago when percutaneous coronary intervention (PCI) was performed with the implantation of multiple stents into coronary arteries. In the following years, progressive decline in systolic function and heart failure developed. His symptoms included fatigue and shortness of breath (NYHA class 4, INTERMACS profile 5). The NT-proBNP value was 3,147 pg/mL. The only comorbidity was diabetes mellitus type 2. He was a long-time smoker with a positive family history of cardiovascular diseases and no prior GI disease.

Echocardiography showed ischemic dilatative cardiomyopathy with poor systolic function (Figures 1 A–D). The left atrium (LA 53 mm; LAVs 101 mL) and the left ventricle (LVIDs 52 mm, LVIDd 74 mm, EDVLV 294 mL, ESVLV 252 mL) were dilated and remodeled, with the ejection fraction of 15% (normal range: 50%–75%) by the Simpson method. The mitral annulus was also dilated (MADd 41 mm; MAAd 13.2 cm^2) with severe mitral regurgitation. Diastolic dysfunction with the restrictive filling pattern was also present (E/e' = 25). The dilated right atrium (RAVs 97 mL), dilated tricuspid annulus (TADd 38 mm, TAAd 11.34 cm^2) with moderate-severe tricuspid regurgitation and dilated right ventricle (RV1 51 mm, RV2 37 mm, RV3 96 mm) were registered as well. The right ventricular systolic function was also evaluated (TAPSE 17 mm, FAC 28%).

Right heart catheterization showed the following hemodynamic parameters: central venous pressure 23 mmHg (normal range: 8–12 mmHg), right ventricular systolic pressure 54 mmHg (normal range: 15–39 mmHg), pulmonary arterial pressure 53/8 mmHg (normal range: 15–39 mmHg), pulmonary arterial wedge pressure 25 mmHg (normal range: 2–14 mmHg), cardiac index 2.49 L/min/m^2 (normal range: 2.6–4.2 L/min/m^2), and systemic vascular resistance 2,279 dynes s/cm^{-5} (normal range: 700–1,500 dynes/s/cm^{-5}).

After detailed preoperative preparation and all the necessary examinations, the patient underwent the implantation of the Heartware LVAD through the standard open surgical approach with transesophageal

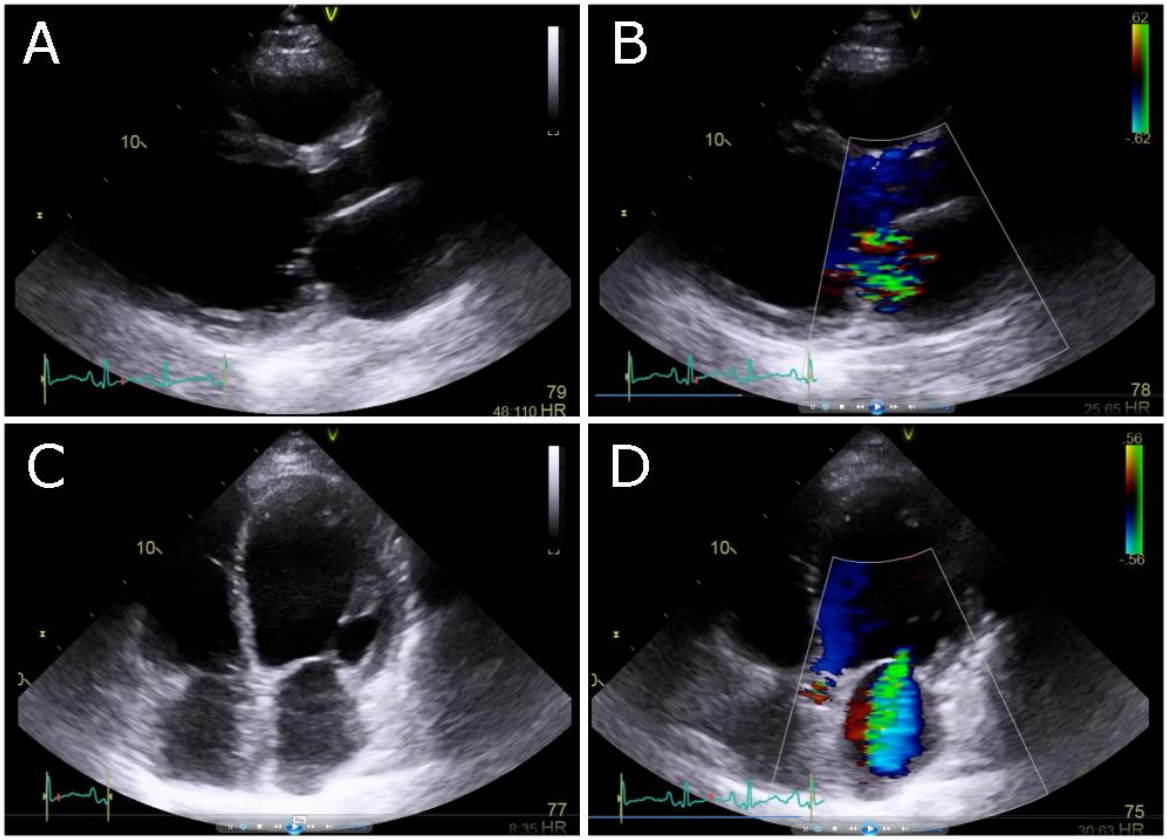

Fig. 1 – Transthoracic echocardiography prior to surgery: A) Parasternal long axis view; B) Parasternal long axis view – Doppler effect; C) Apical four-chamber view; D) Apical four-chamber view – Doppler effect.

echocardiography guidance, using general endotracheal anesthesia and extracorporeal circulation.

The immediate postoperative course was uneventful. The patient was hemodynamically stable with dobutamine (8 μg/kg/min) and noradrenaline (0.03–0.06 μg/kg/min) stimulation. The LVAD was programmed to work at 2,700 rpm, with the blood flow of 5.0 L/min.

Continuous heparin infusion was used for anticoagulation. Oral anticoagulation therapy using acenocoumarol was initiated on the second postoperative day after the removal of chest tubes, with target international normalized ratio (INR) values between 2.0–3.0.

Regular periodic echocardiography was performed according to the standard LVAD protocol. Due to the development of left-sided pleural effusion, the drainage of the left pleural cavity was performed resulting in the evacuation of 2,400 mL of serohemorrhagic fluid (Figures 2, A and B).

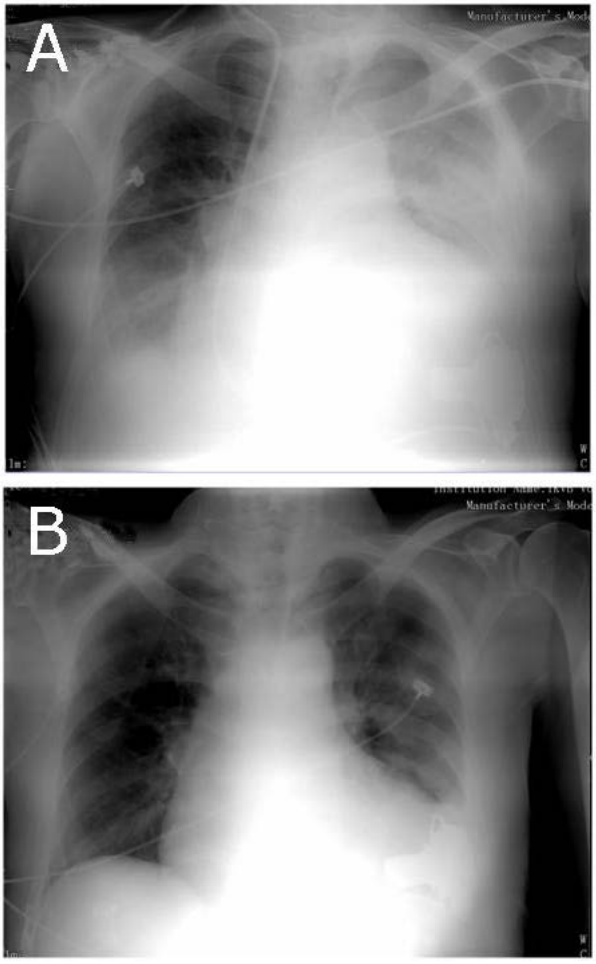

Fig. 2 – Chest X-ray: A) before, and B) after the drainage of the left pleural cavity and intensified diuretic therapy.

The patient was recovering well and all laboratory analyses were normal. Enteral nutrition was gradually introduced, normal intestinal peristalsis was established and the normal stool was formed. The patient was mobilized and intense physical rehabilitation followed.

On the 17th postoperative day, the patient started developing severe anemia. Blood hemoglobin dropped to 69 g/L. Analysis of the red blood cell corpuscular parameters revealed normocytic normochromic anemia. After a transfusion of packed red blood cells, a satisfactory hemoglobin value was established.

His stool was normal and digital rectal examination showed no signs of bleeding. The urine analysis excluded hematuria as a cause of anemia. In search of the source of bleeding, a computed tomography (CT) scan of chest and abdomen with intravenous contrast was performed (Figure 3), however no signs of active bleeding or pathological changes were identified.

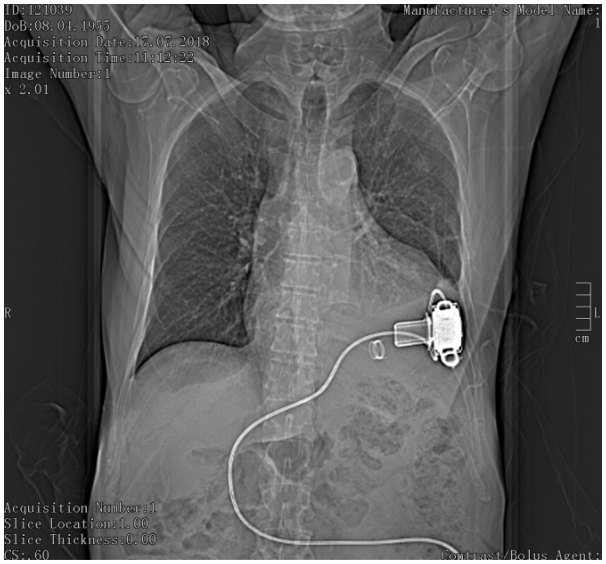

Fig. 3 – Left ventricular assist device implantation position on chest computed tomography.

After a few days, large amount of melena with blood clots appeared, so the endoscopic examination of the GI tract was indicated. Esophagogastroduodenoscopy revealed no signs of active bleeding. Following that, colonoscopy discovered a large amount of hemolyzed blood in the form of film that completely covered the colonic mucosa, stretching over its entire length. However, underlying colonic mucosa appeared to be normal, so the site of active bleeding could not be detected.

The abdomen and pelvis scintigraphy with radiolabeled erythrocytes also did not reveal any signs of active bleeding (Figure 4). Considering that melena with blood clots continued, an exploratory laparotomy was performed. The colon appeared to be filled with large number of parietal thrombi, however no visible pathological changes on the intestinal wall could be identified, so the conclusion was made that this was a case of diffuse colonic bleeding.

Along with the search for the bleeding site, substitution therapy for anemia with numerous packed red blood cells transfusions was applied. Occasionally, blood hemoglobin levels fell below 60 g/L and were partially improved after the transfusions.

At that point, therapeutic values of INR had already been reached, so the oral anticoagulation therapy with

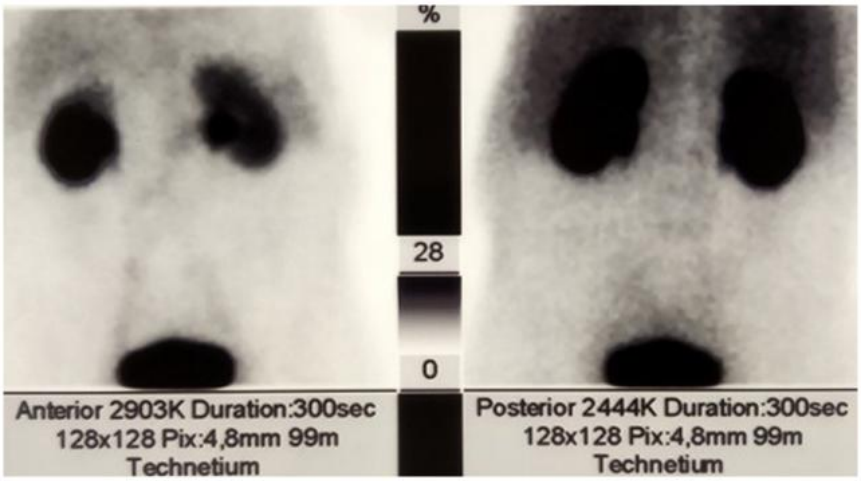

Fig. 4 – Abdomen and pelvis scintigraphy with radiolabeled erythrocytes: no signs of bleeding.

acenocoumarol had to be discontinued immediately. The patient was given fresh frozen plasma, K vitamin substitution, and human prothrombin complex. In order to prevent LVAD thrombosis, low molecular weight heparin was left in therapy. Additionally, subcutaneous administration of the somatostatin analog octreotide was initiated in a dose of 0.1 mg every 8 h. The LVAD speed was gradually reduced from 2,700 to 2,500 rpm, which resulted in blood flow of 4.0 L/min.

After the introduction of octreotide, the GI bleeding stopped, melena disappeared and blood hemoglobin level stabilized. After the patient's general condition improved and the laboratory findings normalized, acenocoumarol was again gradually introduced. LVAD speed was carefully increased to 2,600 rpm, resulting in a flow of 4.5 L/min.

The patient was discharged on the 45th postoperative day with a blood hemoglobin level of 90 g/L, INR values within the therapeutic range and no signs of bleeding. He was discharged with cardiac therapy, along with iron supplementation and mesalazine 2 g per day, as recommended by gastroenterologist.

Seven days after the discharge, the patient came for a check-up. He was feeling well, had no congestive symptoms, and could tolerate moderate physical activity. There were no symptoms and signs of GI bleeding. His blood hemoglobin level was 84 g/L. There was no record of the LVAD alarm activation. Control echocardiography revealed the aortic valve opening with every heartbeat.

Discussion

Bleeding is the most common complication after LVAD implantation and it commonly originates in the GI tract. Most recent data suggest that as much as one third (30–34%) of patients with LVAD exhibit at least one episode of GI bleeding during the first three years [3–5].

GI bleeding following the continuous blood flow LVAD implantation is not associated with any form of preexisting GI lesions, as well as antiplatelet or anticoagulation therapy. The main underlying mechanism responsible for the bleeding in this setting is hypothesized to be angiodysplasia [6].

Angiodysplasia develops due to a narrowed arterial pulse resulting from a decreased aortic valve opening that occurs after the LVAD implantation, causing the loss of normal cardiac cycle and pulsatile blood flow. For this reason, GI bleeding is observed more frequently in LVAD pumps with continuous blood flow in comparison with pulsatile one [2].

The loss of pulsatile blood flow produces dilatation of the intestinal capillaries and venules, as well as a decreased venous outflow [7]. An autopsy study that performed a microscopic analysis of the intestines in patients with continuous flow LVADs discovered a consistent form of angiodysplasia in all the observed samples and concluded that this could be classified as a distinct form of pathology [8].

High shear forces produced by the continuous blood flow result in the increased consumption of the von Willebrand factor, leading to a hemostatic disorder similar to the hereditary von Willebrand disease [9]. The consequent impaired hemostatic cascade and platelet aggregation further contribute to the bleeding risk. This condition, called the acquired von Willebrand syndrome, has been observed in patients with various cardiovascular diseases, such as aortic stenosis, hypertrophic obstructive cardiomyopathy, as well as various forms of mechanical circulatory support like extracorporeal membranous oxygenation (ECMO) and LVAD. Newest discoveries suggest that actually every single patient after LVAD implantation exhibits this disorder in some degree [10].

It seems that our patient was prone to GI bleeding. Some of his medical characteristics, such as the history of coronary artery disease, ischemic cardiomyopathy, high systemic vascular resistance and diabetes mellitus were identified as risk factors for GI bleeding in a recent study on 351 LVAD patients [3].

The bleeding location in our patient was colon, which is not typical. According to literature, the most common site of GI bleeding in LVAD patients is the upper GI tract in almost

half cases, whereas the colon is the source of bleeding in 22%, and small bowel in 15% [11].

The mainstay of the GI bleeding management in our patient was the reduction of the LVAD flow, as well as the introduction of octreotide in therapy. Reduction of the LVAD flow from 2,700 to 2,500 rpm, enabled aortic valve opening with every heart cycle, thus improving pulsatility in the peripheral circulation. This measure is considered as the main approach in the treatment of GI bleeding after LVAD implantation across literature [7, 12].

Octreotide is a somatostatin analogue that causes splanchnic vasoconstriction, improves platelet aggregation and increases vascular resistance [13]. Through these mechanisms, as well as the inhibition of angiogenesis, this drug is capable of stabilizing GI bleeding. The application of octreotide for the GI bleeding in patients with LVAD has been reported to have a notable success [14]. A recent study by Al Bawardy et al. [4] demonstrated that conservative therapy including octreotide is in fact superior to balloon-assisted enteroscopy for the management of LVAD associated GI bleeding.

Additional steps in the medical treatment of GI bleeding in LVAD patients include the ones generally recommended for any form of acute GI bleeding [7, 13, 15]. In our case, they included proton pump inhibitor, fluid replacement, packed red blood cells transfusions and discontinuation of anticoagulation and antiplatelet medication.

Conclusion

It should be noted that acute GI bleeding represents a serious, life-threatening condition that can develop after LVAD implantation. With a comprehensive literature search for the bleeding management strategy in LVAD implanted patients, as well as a remarkable collaboration of the multidisciplinary team, the bleeding was successfully managed and the patient survived.

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Received on August 15, 2019
Revised on September 26, 2019
Accepted October 11, 2019
Online First October, 2019