Author’s response to reviews

Title: Anesthetic management of a patient with a continuous-flow left ventricular assist device for video-assisted thoracoscopic surgery: a case report

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Response: Thank you for providing us the opportunity to revise our manuscript. We have revised the manuscript according to the reviewers’ comments and suggestions. The changes in the manuscript are marked in red font. We have addressed all reviewer comments point by point.

Reviewer reports:

Marco Baciarello (Reviewer 1): Dear Authors,

Thank you for your interest in BMC Anesthesiology.

The case you described is extremely interesting, especially because there's no way around OLV for VATS, and because of the potential effects on RV function that you've been correctly predicting.

I believe this case report is well worth publishing after a few corrections—namely:

1. Please elaborate more on the massive fluid loading the patient underwent before surgery. Clearly, hypovolemia is a problem in all patients at risk of RV dysfunction, but a 4 kg gain seems a lot. Was it really necessary in your opinion? Are there citations about this in the literature?

Response: Thank you for your important comments. We completely agree that hypovolemia is a critical problem in all patients with LVADs. To be more precise, the patient gained 3.5 kg in 4 days preoperatively (Page 5, Line 4). We re-examined the medical and anesthetic records. The body weight entered value in the anesthetic record was not measured on the operation day; therefore, we had misunderstood this point.
We asked the cardiac surgeon who treated the patient regarding the preoperative management. After LVAD implantation, the patient’s clinical course was hemodynamically stable. However, it was difficult to maintain the body weight constant due to excessive urination caused by diuretic administration and high or low intake of water, salt, and food. The body weight was controlled by discontinuing the administration of diuretics and adjusting the intake of food, salt, and water. However, pneumothorax recurred, and the body weight was decreased by loss of appetite. Consequently, the patient lost body weight preoperatively, and needed volume load to avoid occurrence of the sucking phenomenon and thrombus formation.

According to Shah et al, at left ventricular internal diastolic dimension (LVIDD) 7 cm, the hazard ratio for axial configuration, compared to centrifugal configuration (CC), device thrombosis was 1.61 (95% confidence interval [CI], 1.17-2.22; p=0.004) and continued to rise as the LVIDD increased. The cardiac surgeon considered that the patient potentially had higher thrombotic risk because the preoperative LVIDD of the patient was measured at 7.7 cm, although EVAHEART is a centrifugal LVAD. Conversely, in multivariable models, the hazard of stroke was higher with the CC device regardless of LVIDD [1].

In our opinion, it is not necessary for the patient to receive preoperative fluid overloading, especially in elective VATS. Similarly, hypovolemia should also be avoided because it is considered a deteriorative factor for the right heart in LVAD patients as you indicated. To be exact, the patient did not receive massive fluid overloading, but he needed optimal volume management to compensate for body weight loss. However, because he could not maintain an ideal stable body weight preoperatively, he gained 3.5 kg of body weight in 4 days.

Reference


2. You state that the preoperative fluid infusion was meant to reduce the risk of thrombus formation, yet the patient was on IV heparin. Please explain this aspect, as well.

Response: Severe right heart failure is a thrombotic risk factor [2]. Hypovolemia may induce right heart failure in LVAD patients. In addition, the patient had high risk for thrombotic complication as we demonstrated in our response to comment 1. Therefore, preoperative volume management with anticoagulation therapy is important to avoid thrombus formation.

Generally, heparin is used for perioperative bridging in warfarin-treated patients. However, interruption of anticoagulation due to the bleeding risk associated with an elective procedure may also lead to an elevated risk of thromboembolism, even if heparin bridging is implemented. Therefore, a recent study recommended that an extended personalized approach that incorporates the extent of the patient’s underlying risk for thrombosis and bleeding, assesses intrinsic thrombogenicity and the potential variable response to anti-thrombotic agents, and determines the hemostatic influence of pump characteristics is needed to balance the risk of bleeding and thrombotic complications [2].
Reference


3. Please indicate normalized ratios for coagulation times, as the absolute values may vary between different labs and institutions (page 5, line 20-24)

Response: Thank you for your comment. We have added the APTT control value, 32.9 s, with the absolute APTT value, 52.9 s, to page 5, lines 12-13.

4. The sentence "rocuronium was administered before the operation" sounds a little as though the drug was given before the patient was even in the OR. Please change it to "just before the first incision" or something to that effect.

Response: Thank you for comment. Because we are not native English speakers, we are unsure of the nuance in this sentence. We have corrected the sentence as you suggested on page 6, line 5. Additionally, we have consulted a professional English editing company again.

5. Please indicate what drug was actually used for IV PCA, as we only have doses and settings…

Response: Our apologies. We used IV-PCA with fentanyl and have added this information to Page 8, Line 14.

6. Epidural analgesia was actually contraindicated because of the patient's anticoagulation; please cite some alternatives, such as erector spinae block, single shot paravertebral blocks, etc…

Response: Thank you for your suggestion. As you indicated, we also think that epidural anesthesia is contraindicated in a patient with a LVAD that needs anticoagulation therapy. We have added information on a promising alternative analgesia method that was previously reported to page 12, lines 17-Page 13, lines 4.

7. Finally, I suggest a general revision of the language in the manuscript; there are no significant errors, but some sentences and words could use some more nuance.

Response: Our manuscript was checked by Editage (English language editing service company), and has been rechecked for this revision to ensure that the use of the language is appropriate.

Once these minor corrections are applied, I think the manuscript deserves publishing.

Response: Thank you for your valuable comments and suggestions. We hope that we have adequately addressed all your concerns.
Wolfgang Buhre (Reviewer 2): In their interesting case report, the authors describe the perioperative course of a patient with LVAD who needs to undergo thoracic surgery for recurrent pneumothorax. The authors quite carefully described the perioperative course of this patient in order to enable the reader to learn from their experience. In general the manuscript is well written. However, some points require further attention.

1. I do not really understand why the cardiac team decides to give additional filling with crystalloids over a quite long period (resulting weight increase of 4 kg) due to an expected risk of thromboembolic complications (P.5, first para). Please comment on this. Is the anaesthesia performed by an experienced anaesthesiologist in these group of patients?

Response: Thank you for your valuable comments. We asked the cardiac surgeon who managed this patient’s preoperative treatment to assist with the revision of the manuscript. In addition, we re-examined the medical and anesthetic records. To be more precise, the patient gained 3.5 kg in 4 days preoperatively. The body weight value entered in the anesthetic record was not measured on the operation day; therefore, we had misunderstood this point. After LVAD implantation, the patient’s clinical course was hemodynamically stable. However, it was difficult to maintain the body weight constant due to excessive urination caused by diuretic administration and high or low intake of water, salt, and food. The body weight was controlled by discontinuing the administration of diuretics and adjusting the intake of food, salt, and water. However, pneumothorax recurred, and the body weight was decreased by loss of appetite. Preoperatively, the patient lost body weight, and needed volume load to avoid occurrence of the sucking phenomenon and thrombus formation. Consequently, the patient gained 3.5 kg of body weight in 4 days before VATS.

Actually, the anesthetic management of this patient was performed by one cardiothoracic anesthesiologist, one staff anesthesiologist, and one resident anesthesiologist.

2. The topic of pVR increase associated with OLV is nicely discussed, however in the discussion it seems appropriate to highlight the use of other techniques to lower right ventricular afterload and/or preload. Can you please discuss the role of inhalative vasodilatators in this setting?

Response: Thank you for your valuable comments and suggestions. We have discussed the effect of inhaled nitric oxide in the revised manuscript (Page 9, Lines 12-19).

Moreover, a more detailed comparison to other case report can help to understand the reader the different aspect of anaesthesia management, at the moment the discussion is relatively focused on the case instead of comparing the current management with the management of different patients by different groups.

Response: Thank you for your valuable suggestion. We have added some paragraphs to the revised manuscript (Page 9, Lines 5-11). “However, OLV could lead to higher PVR, induced by possible complications such as hypoxemia and hypercarbia, where the RV encounters sudden changes in afterload, preload, and contractility [14]. Therefore, based on the findings of previous studies [3-10], the management of LVAD-supported patients for VATS may be more challenging than that of LVAD-supported patients undergoing noncardiac surgeries, as there may be sudden OLV-associated, deteriorative RV function.”
3. The case section can probably be shortened by a graphic showing the time course of CVP, and medication used to manage the complex haemodynamic situation.

Response: Thank you for your useful suggestion. We have prepared a new Figure 4 including the CVP, ABP, HR data, as you suggested.

4. The value of the PAC in this subgroup of patients is still relevant. I prefer to know if the authors see any additional value of the PAC in retrospect.

Response: According to published reviews of non-cardiac surgeries in patients with LVADs and case reports, PAC is not recommended. However, we believe that PAC will be needed in cases of pulmonary hypertension and/or highly predictable hemodynamic instability during surgery because of progressive right heart failure, for example, for a LVAD patient with low PAP and high CVP (Page 12, Lines 7-10).

5. TEE allows quantification of the right heart function. Can you please include some number (Rv-FAC, etc.) if available.

Response: After reviewing the TEE and anesthetic records, we calculated the RV-FAC and have added the relevant information to our revised manuscript (Page 6, Line 15-16; Page 7, Line 19-20; Page 8, Line 4). Thank you so much for reviewing our manuscript and for the valuable comments.