

Figure. Gradient of risk of NGAL-8 h for predicting maximum absolute $\Delta\text{Cr-48 h}$. $\Delta\text{Cr-48 h}$, creatinine changes at 48-hours; NGAL-8 h, neutrophil gelatinase-associated lipocalin at 8-hours.

adverse outcomes.² Prior studies demonstrate the usefulness of NGAL as an early biomarker of CI-AKI in different scenarios, especially after contrast administration.³ However, the optimal timing for its determination following coronary angiography has not yet been well elucidated. Herein, a formal comparison among different time points revealed that all of them were predictive of $\Delta\text{Cr-48 h}$. Nevertheless, the best performance of NGAL-8 h may help clinicians to identify those patients at higher risk of developing CI-AKI who could benefit from preventive strategies.⁴ In this regard, and in agreement with recent findings,⁵ we note that the volume of iodixanol was not related to CI-AKI.

Some limitations need to be addressed. This is a small single-center study. The low incidence of CI-AKI precludes obtaining robust estimates of risk regarding this endpoint. A confounding variable such as volume of fluid administration before angiography was not routinely registered, precluding analysis of its influence. Lastly, we did not evaluate CI-AKI beyond 48 hours.

In conclusion, NGAL measurements 8 hours postprocedure predict creatinine changes in ACS patients undergoing coronary-angiography and receiving iodixanol as contrast agent.

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SUPPLEMENTARY MATERIAL



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Two Different Sites of Membrane Rupture in the Berlin-Heart EXCOR Ventricular Assist Device



Dos lugares diferentes de rotura de membrana en la asistencia Berlin-Heart Excor

To the Editor,

The Berlin-Heart EXCOR ventricular assist device (Berlin-Heart AG, Germany) is a paracorporeal pulsed flow device driven by a pneumatic mechanism. Currently, the main application is as a bridge to heart transplant, both in adults and children.^{1,2}

The device comprises a pneumatic driving unit, a system of tubes, and a ventricle or pump. This pump is divided into 2 chambers (blood chamber and air chamber) by a 3-layer polyurethane membrane. The negative and positive pressure in diastole and systole, respectively, generated by the drive unit and transmitted to the ventricle, displace the membrane, with the corresponding effect of suction or blood expulsion (Figure 1).

Mechanical problems occur more frequently in pulsed flow devices than in continuous flow ones.³ Membrane rupture is, however, an uncommon problem and has been reported in a limited number of cases,^{4–6} after more than 2000 implants up until 2015. We present 2 cases of membrane rupture in our center.

The first case occurred in a 62-year-old man, with a biventricular Berlin-Heart EXCOR implant after acute myocardial infarction complicated with cardiogenic shock as a bridge to heart transplant. On day 77 of treatment, while the patient was on the ward, a mobile shadow, measuring 3 cm across, was detected in the right pump, with an irregular border and fine bands of adhered fibrin. This image was apparent in systole and disappeared in diastole (Figure 2A and video 1 of the supplementary material). It was only visible in the blood chamber; the membrane appeared normal from the air chamber. The patient was asymptomatic and hemodynamically stable, with no warning alarms showing on the display of the operating panel. Membrane rupture was suspected and an emergency pump change was undertaken. After explanation, a torn area was detected on the internal layer of the membrane (adjacent to the blood chamber).

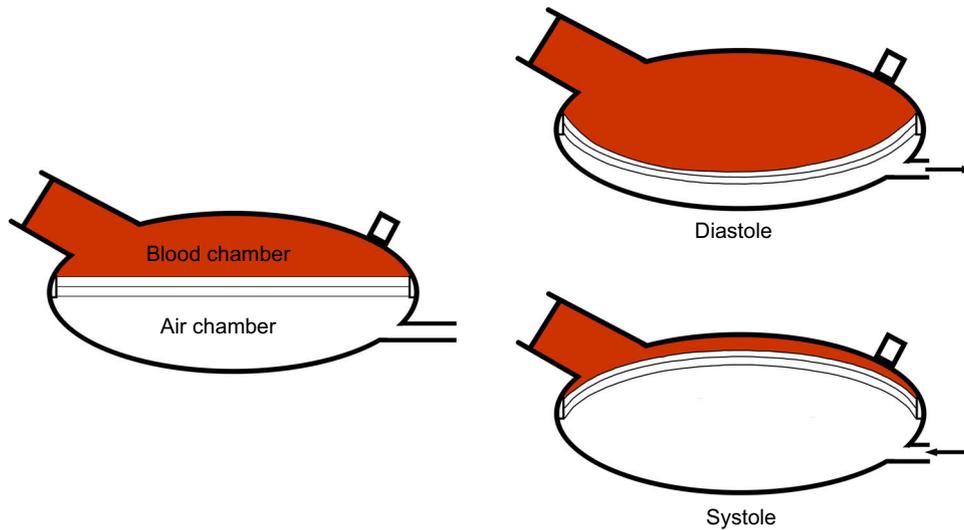


Figure 1. Diagram of the functioning of the Berlin-Heart EXCOR ventricular assist device.

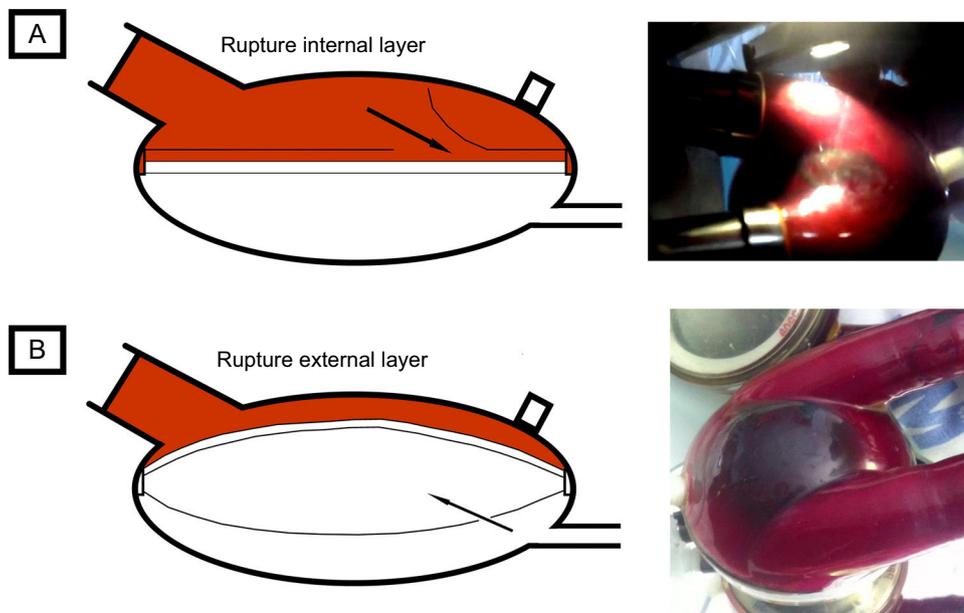


Figure 2. Diagram of membrane rupture. A: Rupture of the internal layer (case 1). B: Rupture of the external layer (case 2).

The second case occurred in a 63-year-old man with dilated cardiomyopathy, who had been implanted with a Berlin-Heart EXCOR device as a bridge to heart transplant. On day 161 of assist, while on the ward, the patient suddenly experienced dyspnea, malaise, and cold sweat. The physical examination confirmed cardiogenic shock, with a warning of “low left ventricular flow” showing on the display of the operating panel. A perfectly round shadow measuring 5 cm in diameter was detected in the blood chamber. This shadow was more evident during device systole (Figure 2B and video 2 of the supplementary material). In the air chamber, a rounded bulge was observed in systole, while the appearance was normal during diastole. Both the shadow and bulge became increasingly marked in the course of minutes. Membrane rupture was suspected and an emergency left pump change was undertaken. After explantation, a small tear (measuring a few millimeters) could be seen on the outer layer of the membrane (adjacent to the air chamber) and air was trapped between the external and middle layer.

Both cases illustrate 2 different presentations of membrane rupture. To date, cases of rupture of the internal and external layer of the membrane have been described (with no reports of rupture of the middle layer).

Rupture of the internal layer (first patient) meant that the blood came into contact with the nonbiocompatible surfaces between the internal and middle layer, thereby favoring the formation of fibrin and thrombi in this area. The middle and external layers remained intact and pump function was maintained. As the tear spread, a flap could be detected in the blood chamber. This appeared and disappeared during the device cycle, with an irregular border and chaotic movement (Figure 2A). By contrast, the appearance from the air chamber was normal. This type of rupture, therefore, increases the risk of thrombosis, and it is hemodynamically tolerated because the assist device continues to function correctly.

Rupture of the outermost layer (second case) led to progressive air entrapment between the middle and external layer: the air

entered in the space during systole, and its exit in diastole was hindered by the valve effect generated by the suction of the device (Figure 2B). External examination revealed a rounded shadow in the blood chamber during systole, whereas a rounded bulge was seen in the air chamber during systole. This mechanism of air entrapment led to progressive pump dysfunction (pump obstruction) that had a substantial hemodynamic impact on the patient. In this situation, cardiogenic shock can develop in a question of minutes.

The 2 cases presented and the schematics help us to understand the development of this complication, each one with a different appearance on examination, different clinical course, and different associated complications. In our opinion, awareness of this complication and its pathophysiology is important for early detection, as emergency replacement of the ventricle is essential to avoid adverse outcomes.

SUPPLEMENTARY MATERIAL



Supplementary material associated with this article can be found in the online version at doi:10.1016/j.rec.2016.01.021.

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Mid Term Bleeding Risk Prediction After an Acute Coronary Syndrome: An Unsolved Question



Predicción del riesgo hemorrágico a medio plazo tras un síndrome coronario agudo: una asignatura pendiente

To the Editor,

Bleeding complications are associated with worse prognosis in patients with acute coronary syndrome (ACS).¹ In recent years, different scales have been developed to predict in-hospital bleeding complications in ACS,²⁻⁴ and these scales have been shown to have acceptable predictive power in different scenarios.⁵ However, these scales have not been validated for predicting bleeding complications outside the hospital setting.

The objective of this study was to assess prediction of bleeding by the CRUSADE,² Mehran,³ and ACTION⁴ bleeding risk scales 1 year after hospital discharge and to compare the predictive power with that shown by the 3 scales for predicting in-hospital bleeding events.

This was a retrospective study of prospectively followed patients admitted to the coronary unit of a tertiary hospital for ACS between October 2009 and April 2014. The scores on the CRUSADE,² Mehran,³ and ACTION⁴ scales were calculated for each patient. To define in-hospital bleeding, the Bleeding Academic Research Consortium (BARC) definition was used (types 3 and 5).⁶

Follow-up at 1 year was undertaken through chart review or telephone contact. The development of clinically relevant bleeding events, defined as those that required hospitalization, transfusion of ≥ 1 blood pack, or suspension of antithrombotic treatment, was recorded.

The predictive power of these 3 scales for predicting in-hospital bleeding was analyzed by means of binary logistic regression analysis and by calculation of areas under curve (AUCs) of the receiver operating characteristics (ROC) curves, with comparison using the DeLong method. The predictive power of

the 3 scales for bleeding during follow-up was analyzed by Fine and Gray comparison of competing risks (with death as a competing event), and by calculation of the corresponding AUC of the ROC curves, with comparison as before with the DeLong method.

Of the 1489 patients included, with a mean age of 62.5 years, 77.7% were men. Forty-nine patients (3.3%) had type 3 or 5 BARC bleeding events during hospitalization. In-hospital mortality was 6.3%. Of the 94 patients who died in hospital, 35 (37.2%) died of noncardiac causes and 5 (5.3%) died of bleeding complications.

In total, 1375 patients entered follow-up (97.9%, median follow-up time of 365 days), and during this period, 69 patients had bleeding complications and 73 died. The mean time to bleeding event after discharge was 169 days. Eight (11.6%) of these bleeding events occurred in the first 30 days, and 38 events (55.1%) were reported in the first 6 months. The most frequently reported type of bleeding after discharge was urinary bleeding in 24 patients (34.8%), followed by gastrointestinal bleeding in 16 (23.2%), respiratory system bleeding in 15 (21.7%), intracranial bleeding in 5 (7.2%), and muscle bleeding in 5 (7.2%).

Of the 73 patients who died during follow-up, 43 (58.9%) died of noncardiac causes and 4 (5.5%) due to bleeding complications.

In the overall patient population, the 3 scales showed a good predictive power for in-hospital bleeding (Table), with no

Table

Area Under Curve of Different Scales for Predicting Bleeding Events

Scale	In-hospital bleeding (AUC [95%CI])	Bleeding during follow-up (AUC [95%CI])
CRUSADE	0.75 (0.67-0.82)	0.58 (0.51-0.65)
Mehran	0.71 (0.65-0.78)	0.58 (0.50-0.65)
ACTION	0.73 (0.65-0.81)	0.57 (0.50-0.64)

AUC, area under ROC curve; CI, confidence interval.