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Table 1 Multivariate logistic regression results

Variable	Odds ratio for in-hospital mortality	95 % CI	p value
Age (per year)	1.01	0.99, 1.04	0.27
ECLS type (VV vs. VA)	0.53	0.18, 1.58	0.11
GI bleeding	5.91	1.44, 24.25	0.01
Indication for ECLS (ARDS vs. postcardiotomy shock)	0.48	0.13, 1.83	0.43
Red blood cell transfusion (per unit)	1.02	0.99, 1.04	0.08

ARDS acute respiratory distress syndrome, CI confidence interval, ECLS extracorporeal life support, GI gastrointestinal, VA veno-arterial, VV veno-venous

Epidemiology of gastrointestinal bleeding in adult patients on extracorporeal life support

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Dear Editor,
Gastrointestinal (GI) bleeding is associated with high mortality in critically ill patients [1]. Stress ulcer prophylaxis has reduced its incidence; however, some patients remain at risk. There are few data about GI bleeding during adult extracorporeal life support (ECLS). We performed a retrospective cohort study to determine its incidence and impact on mortality.

The institutional review board approved our study. A total of 132 patients were included over 3.5 years. Fifty-four patients had veno-arterial (VA) ECLS, 64 patients had veno-venous (VV) ECLS, and 14 patients had sequential therapy. The median number of ECLS days was 7. GI bleeding was defined as hematemesis, melena, or hematochezia. Anticoagulation was with heparin and anticoagulation goals were an activated clotting time (ACT) of 180–200 s or activated partial thromboplastin time (aPTT) of 60–80 s for VA ECLS and an ACT of

140–160 s or aPTT of 45–55 s for VV ECLS.

Eighteen patients (13.6 %) experienced GI bleeding. These patients had longer ECLS courses (12 days vs. 7 days, $p = 0.002$) and higher in-hospital mortality (83.3 vs. 43.9 %, $p = 0.002$) (Table 2 in the supplementary material). The median presentation day was 8 with most patients ($n = 10$, 55.6 %) having coffee ground emesis. Details of the bleeds are listed in Table 3 in the supplementary material. Esophagogastroduodenoscopy was performed in seven patients and the most frequent diagnosis was stress gastritis. Most patients were managed with transfusion, hematocrit monitoring, and proton pump inhibitors. Three patients had their anticoagulation temporarily held. GI bleeding was independently associated with in-hospital mortality (OR 5.91; 95 % CI 1.44, 24.25; $p = 0.01$) after controlling for important confounders (Table 1).

GI bleeding may be more frequent in ECLS patients as a result of multifactorial coagulopathy, generation of systemic inflammation, and non-pulsatile blood flow during VA ECLS, which can lead to reduced gastric perfusion and pH [2–5]. Future prospective studies would be helpful in confirming our findings.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no conflict of interest.

References

1. Cook DJ, Fuller HD, Guyatt GH, Marshall JC, Leasa D, Hall R, Winton TL, Rutledge F, Todd T, Roy P, Lacroix J, Griffith L, Wilan A (1994) Risk factors for gastrointestinal bleeding in critically ill patients. *N Engl J Med* 330:377–381
2. Heilman C, Geisen U, Beyersdorf F, Nakamura L, Benk C, Trummer G, Berchtold-Herz M, Schlensak C, Zieger B (2012) Acquired von Willebrand syndrome in patients with extracorporeal life support (ECLS). *Intensive Care Med* 38:62–68
3. Mutlak H, Reyher C, Meybohm P, Papadopoulos N, Hanke AA, Zacharowski K, Wever CF (2015) Multiple electrode aggregometry for the assessment of acquired platelet dysfunction during extracorporeal membrane oxygenation. *J Thorac Cardiovasc Surg* 63:21–27
4. McIlwain B, Timpa J, Kurundkar AR, Holt DW, Kelly DR, Hartman Y, Neel ML, Karnatak RK, Schelonka R, Arantharamaiah GM, Killingsworth CR, Maheshwari A (2010) Plasma concentrations of inflammatory cytokines rise rapidly during ECMO-related SIRS due to release of pre-formed stores in the intestine. *Lab Invest* 90:128–129
5. Gaer JA, Shaw AD, Wild R, Swift RI, Munsch CM, Smith PL, Taylor KM (1994) Effect of cardiopulmonary bypass on gastrointestinal perfusion and function. *Ann Thorac Surg* 57:371–375

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