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Authors' reply

We thank Yang Zhang and colleagues for their thoughtful letter in response to our study of extracorporeal membrane oxygenation (ECMO) support for COVID-19 from the Extracorporeal Life Support Organization (ELSO) Registry.¹ They raise difficult questions concerning bleeding, thrombosis, and the use of anticoagulation in patients with COVID-19 receiving ECMO support.

Before the COVID-19 pandemic, considerable international practice variation and uncertainty existed regarding the optimal anticoagulation strategy during ECMO.² In part, consensus is lacking because the key outcomes of bleeding and clotting are multifactorial in origin and might also be disease-specific. Consequently, determining the role of ECMO and anticoagulation in bleeding and clotting events is difficult outside of randomised clinical trials. For example, in the ECMO to Rescue Lung Injury in Severe ARDS Trial,³ bleeding that led to transfusion was more common in patients receiving ECMO support, but massive bleeding and haemorrhagic stroke occurred at comparable rates between the treatment and control groups.

COVID-19 has compounded this uncertainty. Compared with patients in the ELSO Registry who received ECMO support in 2019, we found no evidence of increased rates of mechanical failure or patient-related bleeding complications in patients with COVID-19.¹ However, in another report,⁴ 19% of patients with COVID-19 receiving ECMO support had pulmonary embolism during ECMO; in response, the investigators increased the anti-Xa target. It is unknown to what extent higher doses of anticoagulation reduce thrombotic complications in patients with COVID-19 receiving ECMO support and whether these higher doses of anticoagulation increase the risk of major haemorrhagic events.

We acknowledge that the pathophysiology of COVID-19 might put patients at greater risk of haematological complications. However, the observational nature of our study and the absence of comparison groups prevent us from addressing whether ECMO in general, or whether specific anticoagulation strategies, were differentially associated with bleeding or thrombotic complications.

To address the relationship between anticoagulation, bleeding, and thrombosis in patients receiving ECMO support, investigators need to identify core data elements that rigorously characterise anticoagulation practice, address plausible confounders, and measure validated indices of bleeding, thrombosis, and related outcomes. Without this foundational work, observational studies of anticoagulation, bleeding, and thrombosis during ECMO might yield misleading results. Once completed, ECMO databases such as the ELSO Registry should incorporate that work. Both mechanistic and randomised clinical trials will be required to discern the relationship between ECMO anticoagulation strategies and haematologic outcomes.

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Adhesions after open and laparoscopic abdominal surgery

In the SCAR update, Pepijn Krielen and colleagues¹ suggested that laparoscopic abdominal surgery reduces the incidence of adhesion-related readmissions. In a linked Comment, Liane S Feldman and Raul J Rosenthal argued for more widespread use of laparoscopic surgery.² Laparoscopic surgery is increasingly used³ and has advantages, such as reduced hospital stay, but it has limitations too.⁴ We have concerns about the generalisability of the SCAR data and



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