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RESPONSE TO LETTER

Interpreting Blood Transfusion in Hip Fracture Surgery: Marker of Severity Rather Than Mediator of Harm? [Response to Letter]

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Dear editor

We are grateful to Ahmad, Harris, Fertleman, and Koizia for their careful and constructive engagement with our study examining risk factors for post-operative blood transfusion and its association with outcomes following hip fracture surgery.[1,2]

The correspondents raise four substantive points regarding unmeasured confounding, the temporal relationship between transfusion and ICU admission, the higher-than-expected transfusion rate, and the statistical methodology employed. We respond to each in turn.

Unmeasured Confounders: Frailty, Functional Status, and Intraoperative Factors

We acknowledge this as a valid and important limitation. Formal frailty indices, pre-fracture functional status, intraoperative estimated blood loss, and perioperative haemodynamic instability were not captured in our dataset, and their absence represents a genuine constraint of the retrospective, multicentre design. As the authors note, frailty and comorbidity burden independently predict short-term mortality and postoperative escalation in hip fracture surgery, and their omission likely contributes to residual confounding that our multivariable models cannot fully eliminate.

This concern, however, reinforces rather than undermines our central conclusion: that transfusion, after adjustment for measured confounders, was not independently associated with all-cause mortality. Were frailty and physiological reserve to be accounted for, any residual association between transfusion and mortality would likely attenuate further. We agree that prospective studies incorporating validated frailty instruments and granular perioperative haemodynamic data are needed to resolve this question definitively.

Temporal Relationship Between Transfusion and ICU Admission

We agree that the causal direction between transfusion and ICU admission is difficult to establish within our retrospective framework. ICU transfer may precede transfusion in cases of haemodynamic deterioration, or transfusion may itself trigger escalation of care in patients with adverse reactions or evolving complications. Without time-stamped event data,

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our study cannot resolve this directionality, and we concede that the independent association between transfusion and ICU admission (OR = 2.17) should be interpreted with appropriate caution.

Time-dependent modelling or formal mediation analysis, as suggested, would be valuable avenues for future research. Nonetheless, we maintain that the observed association — regardless of directionality — is clinically meaningful: it identifies a subgroup of patients requiring proactive postoperative planning and highlights the importance of integrating transfusion decision-making within a broader perioperative risk management strategy.[3]

Transfusion Rate and Regional Context

The correspondents note that our transfusion rate of 35.8% appears higher than those reported in some national cohorts. We appreciate this contextualisation. We believe this difference is at least partly attributable to the regional healthcare setting: our cohort was drawn from three Jordanian tertiary centres, where preoperative anaemia prevalence may differ from that in Western populations, and where access to and thresholds for perioperative Patient Blood Management (PBM) interventions — including pre-operative iron supplementation and tranexamic acid — may not yet be uniformly implemented.[4,5]

Indeed, one of the key motivations for this study was precisely to provide regional data that could inform and refine local transfusion protocols, as comparative data from the Middle East remain scarce. The absence of data on transfusion timing, number of units administered, and use of antifibrinolytics such as tranexamic acid is a limitation we acknowledge. These variables would have meaningfully contextualised the transfusion rate and refined the risk factor analysis, and we encourage future prospective studies in this setting to capture them systematically.

Statistical Methodology: Stepwise Logistic Regression

We acknowledge the methodological concern raised regarding the use of forward stepwise logistic regression with p-value-based entry and removal criteria. This approach, while widely used in observational surgical research, carries well-recognised risks of model instability, overfitting, and reduced external generalisability.[6] The correspondents' recommendation to use pre-specified variable selection informed by clinical and biological plausibility, complemented by internal validation techniques such as bootstrapping or cross-validation, is well-taken and reflects contemporary best practice in prognostic modelling.

In defence of our approach, the variables included in the multivariable model were not selected purely on statistical grounds: clinically relevant factors including age, sex, comorbidities, preoperative haemoglobin, and anaesthesia type were retained regardless of univariate p-values. Nonetheless, we agree that future analyses would benefit from a more rigorous pre-specified modelling strategy, and we encourage replication of these findings in larger prospective cohorts with formal internal validation.

In conclusion, we welcome the correspondents' framing of transfusion within a broader model of geriatric vulnerability, integrating frailty, physiological reserve, and perioperative blood management. This perspective is entirely consistent with our conclusions and with the growing evidence base supporting individualised, PBM-guided care in elderly hip fracture patients. We hope that this study, and the discussion it has generated, will contribute to the development of more robust transfusion practices and clinical pathways in this high-risk and under-studied regional population.

We thank Ahmad et al for their thoughtful and scholarly engagement with our work.

Disclosure

The authors report no conflicts of interest in this communication.

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