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Clinical assessment or scoring model for acute lung injury: a crossing path?

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Running head: Lung injury

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Acute type A aortic dissection (ATAAD) is a clinical emergency and is associated with significant mortality and morbidity which necessitates immediate surgical intervention.[1] Although surgical techniques have improved over time, resulting in lower mortality rates,[2] the high incidence of post-operative complications remains the primary factor influencing the patient's long term outlook. One of these complications is acute lung injury (ALI), a major cause of post-operative mortality with an incidence of 15 to 30%.[3] Wang *et al.* should be commended for developing a scoring model for severe ALI following ATAAD and highlighting the predictive risk factors. [4]

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The results of this study extend the findings of the previous models that predict ALI following ATAAD and are comparable to what is reported elsewhere in the literature.[5,6,7] However, Wang et al are the first to incorporate the pre-operative echocardiographic variables in the predictive model and demonstrated that left atrial (LA) diameter [?] 35.5 mm and left ventricular posterior wall thickness (LVPWT) [?] 10.5 mm were independent risk factors for severe ALI after ATAAD. This warrants future research regarding potential underlying mechanisms, particularly the role of left ventricular diastolic dysfunction of which these are both soft indicators, and the extended role of echocardiography in predicting complications following ATAAD repair. In comparison to the previous models, [5–7] the authors included variables that were available in the emergency, pre-operative setting. This allows clinicians to identify patients at risk of developing severe ALI and assist in timely intervention, potentially leading to better outcomes. This is particularly useful in low-resource settings, where cost and technology are major limitations for the management of these high-risk patients. [8]

Although the prediction model by Wang *et al* . uses a very reasonable method, several significant limitations should be acknowledged. Firstly, the ALI and non-ALI groups were significantly different regarding the percentage of obese patients – with 5.8% in the non-ALI group and three times the value in the ALI group.[4] Prior work shows that obese patients are at risk of requiring higher inspiratory pressures, and therefore excess barotrauma subsequently increasing their post-operative ALI risk.[9] Furthermore, obesity is associated with a high risk of atelectasis during the perioperative period due to the effect of additional thoracic wall weight and abdominal fat mass impinging diaphragmatic excursion. This leads to a reduction in functional residual capacity, arterial oxygenation and the requirement for higher positive end expiratory pressure (PEEP).[9]

Another significant limitation is the inclusion of neutrophils as the surrogate inflammatory marker in the statistical analysis; other markers such as c-reactive proteins (CRP) and interleukin 6 (IL-6) were not included despite being validated to be associated with ALI post ATAAD surgeries. [4] The authors were unable to explain the exclusion of other white blood cell parameters and the neutrophil to lymphocyte ratio when assessing the extent of inflammation.

During ATAAD surgeries, blood transfusion is almost ubiquitous due to the profound coagulopathy associated with a long cardiopulmonary bypass time and extensive surgery. Therefore, there is an associated risk of acute respiratory distress syndrome (ARDS) that occurs through several mechanisms.[10] Transfusion-related acute lung injury (TRALI) is a serious complication that is characterised by a quick onset of hypoxia and bilateral lung infiltration and a high mortality rate of 5% to 25%.[10] Blood products containing leukocyte antibodies, lipids and cytokines will elevate pulmonary vascular permeability, thereby causing lung damage and capillary leakage.[10] Blood transfusion should also be considered as an independent risk factor for postoperative acute respiratory distress syndrome in patients undergoing ATAAD repairs.[10] Achieving meticulous haemostasis and improving surgical techniques in order to reduce perioperative blood transfusions are both parts of a targeted strategy to prevent TRALI.[10] An alternative mechanism for the development of ARDS in this setting it transfusion-associated circulatory overload (TACO).[10] Patients who develop this complication often show improvement from diuresis, but it can be difficult to distinguish from TRALI in its immediate presentation.[10] Platelet activation is also a recognised independent risk factor for ALI in patients with ATAAD, as they are activated by inflammatory mediators such as thromboxane A2 (TXA2).[11] Platelet count is reduced in patients with an unruptured abdominal aortic aneurysm, and thrombocytopaenia has been proposed as a method to predict the increased risk of in-hospital mortality of patients with ATAAD.[11]

Alongside inflammatory markers, certain demographic features should be considered as an independent risk factor for high mortality in patients with ATAAD. It is well recognised that ageing increases the risk of thrombolytic and inflammatory disorders, and therefore mortality in this cohort.[11] Ageing is also associated with intrinsic platelet activation, aggregation and secretion which increases the risk of ALI due to increased vascular permeability.[11]

This is a new prediction model, so there remains a need for long-term follow-up and further validation of the system in other centres in order to bolster confidence in it and suitability for more widespread use. The model holds great promise based on extensive statistical assessment and a large patient cohort. Various independent risk factors of ALI in patients with ATAAD, however, have been outlined in other publications, and these should be carefully considered during the perioperative care of ATAAD patients to optimise outcomes.

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