Application of new specific biomarkers for organ damage after open and endovascular thoracoabdominal aortic aneurysm surgery as model for more accurate perioperative patients' surveillance

Chapter 13

Scientific and Social Impact

Open TAAA repair remains a relevant and necessary surgical approach for treating potentially life-threatening aortic pathologies. Open repair is especially the only option for surgical therapy and cure in young patients suffering from connective tissue disease (e.g., Marfan syndrome), in patients with infected aortic aneurysms, or after failed endovascular procedures. Despite improvements in procedural techniques and moderation of the intensity of aortic cross-clamping–induced ischaemia-reperfusion damage, the relevant rate of perioperative complications, such as AKI, SCI, and pulmonary failure, as well as long-term ventilation remains unclear. Even in experienced centres such as Maastricht and Aachen, where distal aortic perfusion and selective perfusion of the viscero-renal vessels are part of the standard procedure during open TAAA repair, major complication rates of more than 20% are common.

Today, endovascular TAAA repair is an adequate treatment alternative in most cases. This observation emphasizes the importance of scientific analysis of outcomes with open TAAA repair, with the aim of improving surgical and perioperative modalities. Even if patients receive adequate treatment in the intensive care unit (ICU), assessment during the first 24 hours remains a challenge, and established tools enabling detection of adverse outcomes and organ failure may not work. Novel biomarkers could enable timely assessment of clinical but undetectable organ failure, leading to earlier treatment and potentially better patient outcomes. Based on the findings described in this thesis, the evaluated biomarkers, alone or in combination, could be entered into clinical practise and be applied in ICU monitoring after major surgery. Such a tool could potentially lead to more precise detection and treatment of adverse outcomes. In the 21st century, biomarkers could strengthen the application of artificial intelligence in ICU wards, which relies on clinical surrogate parameters such as laboratory findings, enabling early detection of organ failure. The close scientific cooperation of the PhD candidate's working group with companies such as Sphingotec® (Berlin) will be helpful in assessing the reasonable application of biomarkers after major surgery in general.

Insights from these studies focussing on complex aortic surgery may be transferred to or re-evaluated in other surgical settings. The perspective from a prospective, multicentre TAAA study focussing on early detection of AKI is unique in Germany and, as far as the author is aware, possibly Europe. The candidate hopes that the findings described in this PhD thesis

will one day be seen as a step toward a better understanding of pathophysiological changes following open TAAA repair.

Our studies underline the consistently relevant rate of major complications following open (and to a lesser extent, endovascular) surgery. Although surgical techniques such as open TAAA repair have evolved to improve patient outcomes, a more accurate and timely postoperative assessment based on early use of biomarkers of organ damage, e.g., AKI, seems necessary. A prospective, multicentre assessment of outcomes after open TAAA repair in combination with a biomarker panel could advance understanding of pathophysiological changes, such as the dysregulated inflammation reaction following aortic cross-clamping.

Finally, biomarkers could reduce therapy costs for patients undergoing emergency and elective major surgery by leading to a shorter stay in the ICU, shorter artificial ventilation time, and faster recovery after surgery.

The biomarkers evaluated here are relevant to postoperative or postinterventional adverse effects, and their potential role as prognostic indicators was not assessed in the included studies.