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EDITORIAL

Scientific research in the perioperative period: facing a changing (digital) context

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Anaesthesia for surgical procedures has become increasingly safer, with a current mortality rate of about one in 100,000 patients in the Netherlands. In contrast, complication rates following anaesthesia and non-cardiac surgery are notably high, with a reported incidence of up to 50% in a recent trial involving Dutch patients.[1] Postoperative complications delay patient recovery, and may consequently result in a prolonged length of hospital stay and increased healthcare costs. Despite the high postoperative complication rates, this subject is relatively unexposed in the scientific literature and the transition towards anaesthesia as perioperative medicine is still at an early stage in the Netherlands. With the institution of the Perioperative Surgical Home initiative by the American Society of Anesthesiologists (ASA), it is however expected that the attention for patient-centred care for the surgical patient will gradually increase, with emphasis on quality of care and patient outcomes.[2,3]

The relatively little attention for the occurrence of postoperative complications following non-cardiac surgery might be explained as follows. First, scientific research focusing on the pathophysiology, diagnosis and treatment of postoperative complications is rather complex. In addition to common factors that influence the complication risk, such as age, patient morbidity, medication use and the invasiveness of the surgical procedure, aspects such as the multidisciplinary nature of perioperative care and the quality of care in an individual hospital complicate scientific research. Second, postoperative visits by anaesthetists are not (yet) part of routine clinical care in every hospital, which limits standardised evaluation of the outcome after anaesthesia and surgery. Digital innovations that enhance our insight into the origin of postoperative complications may guide the development of new diagnostics and therapeutic interventions.

Big data

Big data are large datasets that combine input from different sources and are characterised by high-volume, high-velocity and high-variety. Big data are increasingly used in healthcare systems as a result of digitising patient records, which facilitates coupling of demographics, economic information, hospital information and patient health data. An interesting aspect of big data is that it allows pattern recognition in large patient populations, and may be used to create prediction models, improve quality of care and avoid preventable deaths.

Pattern recognition in large datasets may enhance our insight into complex healthcare processes. An example of a large database is the VU Amsterdam Cardiosurgical database, which contains more than 120 variables of cardiosurgical patients over the last 20 years.[4] By defining changes in clinical practice in cardiothoracic surgery over time and relating these changes to patient outcome parameters, such as perioperative blood loss, allogeneic blood transfusions and mortality, we could distinguish novel parameters that are interesting for prospective evaluation. This approach contributed to a steep decrease in perioperative blood loss and transfusion requirements in cardiac surgery in our centre.[4]

Pattern recognition in a large database may be considered to be inferior to a randomised controlled study design. However, in light of the high costs of randomised controlled trials, the limitations of patient selection, the representativeness of the control group, the difficulty to repeat large clinical trials and the publication delay, big data analysis should be considered an important opportunity in clinical research.[5] The only requirements for the development and implementation of big data studies as a novel research tool are a consistent privacy regulation for patient data, the development of analytical platforms that can deal with large datasets and the institution of a best practice for big data analysis techniques. If these restrictions are overcome, pattern recognition may contribute to our insight into factors that increase the risk for the development of postoperative complications.

Imaging of the black box: the microcirculation

There is an epidemic of studies focusing on the benefits of goal-directed therapy (GDT) for the guidance of systemic haemodynamics and fluid load in non-cardiac surgery. Interestingly, there are almost as many positive as negative studies with respect to outcome following GDT strategies. This is frequently explained by the risk profile of included patients, the risk profile of the surgical procedure, the applied fluids and vasoactive interventions, and the parameters chosen to guide GDT.

Despite the continuing innovation in haemodynamic monitoring devices, the challenge we face is that most indices are only surrogate parameters for local tissue perfusion. Most publications therefore do not address the most important question in this context: does GDT improve tissue perfusion on a local level? In particular, we recently showed that GDT through optimisation of cardiac index and pulse pressure variation did not influence microcirculatory perfusion as measured by side-stream dark field imaging.[6] Our data suggest that the macrocirculation and microcirculation are uncoupled above a mean arterial pressure between 50-60 mmHg, and interventions aiming for improving microcirculatory perfusion may only be successful below this mean arterial pressure, or in case of an inflammatory condition. Novel innovations should therefore focus on local tissue measurements that reveal information about microcirculatory perfusion disturbances, endothelial and glycocalyx integrity, and oxygen metabolism. A better understanding of microcirculatory behaviour may in part be explanatory for the development of severe complications, such as renal failure or pulmonary oedema.

Remote monitoring

Remote monitoring or telemetry allows continuous evaluation of vital parameters in the preoperative or postoperative period using a smartphone or tablet in patients who are not admitted to an intensive care unit. These devices may particularly be used to change our postoperative care from an expectant, reactive clinical practice (i.e. alarming emergency intervention teams for patients with severely impaired vital organ function) to a proactive one. In particular, remote monitoring in combination with early warning scores may facilitate early recognition of complications and contribute to a reduction of the 'failure to rescue' rate, meaning that the number of patients that progress into a severe postoperative complication is reduced. For example, non-invasive monitoring of the respiratory rate may show early deteriorations of pulmonary function before severe alterations in patient oxygenation occur, which allows prompt intervention and prevention of severe pulmonary dysfunction.

Perioperative research: a changing context

Digital innovations also promote an increasing transparency and visibility of our scientific work through the world wide web. While many scientists avoid the use of social internet platforms, including Twitter® and Facebook®, social platforms will more and more influence our objectivity. First, due to the possibility to 'like' internet information, there is an automatic ranking of news items based on popularity among internet users. A limitation of this trend is that information with the highest ranking is not per se information with the best quality of data or use of sources. Second, the introduction of internet activity scales for scientific publications, such as Altmetrics, offers a novel dimension to the ranking of scientific papers. While papers that appeal to a large proportion of the readership may end up high in these rankings, high-quality specialised scientific papers may end up in the lowest regions due to their limited interest for a broader community. Moreover, these rankings may be increasingly used to assess the societal impact of scientific research, which is more and more acknowledged as estimate of research quality. These contextual changes warrant a detailed evaluation of the societal impact of perioperative research, and the development of a strategy that increases the awareness among the Dutch population that anaesthesia itself may have a major impact on the development of complications and the quality of life following surgery.

In summary, anaesthetists face a transition during which the scope of their role will broaden towards that of the perioperative physician, with increasing attention for the pathophysiology, diagnosis and treatment of postoperative complications. Emphasis on the importance of postoperative complications for patient recovery and quality of life will increase the societal impact of perioperative research. Digital innovations, such as big data, novel imaging techniques, remote monitoring and scientific internet platforms may facilitate this transition.

Disclosures

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References

1. Hemmes SN, Gama de Abreu M, Pelosi P, Schultz MJ; PROVE Network Investigators for the Clinical Trial Network of the European Society of Anaesthesiology. High versus low positive end-expiratory pressure during general anaesthesia for open abdominal surgery (PROVHILO trial): a multicentre randomised controlled trial. Lancet. 2014;384:495-503.
2. American Society of Anesthesiologists. The perioperative or surgical home. Washington, DC: American Society of Anesthesiologists; 2011.
3. Mackey DC, Schweitzer MP. The Future of Surgical Care in the U.S.: State Surgical Quality Collaboratives, Optimized Perioperative Care, and the Perioperative Surgical Home. ASA Monitor. 2014;78:10-3.
4. Vonk AB, Meesters MI, van Dijk WB, et al. Ten-year patterns in blood product utilization during cardiothoracic surgery with cardiopulmonary bypass in a tertiary hospital. Transfusion. 2014;54:2608-16.
5. Angus DC. Fusing randomized trials with big data: the key to self-learning health care systems? JAMA. 2015;314:767-68.
6. Stens J, de Wolf SP, van der Zwan RJ, et al. Microcirculatory perfusion during different perioperative hemodynamic strategies. Microcirculation. 2015;22:267-75.