Opinion

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Cardiothoracic and Vascular Anesthesia for Vascular Surgery and Pain Management

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Description

There is increasing evidence that anesthetics may intrinsically alter the microcirculation in various parts of the body, as the microcirculation is severely compromised in many pathological conditions that anesthesiologists frequently encounter. Variable vascular reactivity may also affect changes in the microcirculation caused by anesthesia exposure in vascular disease patients. In developed nations, the number of such patients undergoing major and complicated surgical procedures is consistently rising. The anesthetic plan for certain procedures and patients may be altered by knowledge of the microcirculatory effects of anesthetics. This review provides a synopsis of the most recent methods for determining the state of the microcirculatory system, as well as the most recent understanding of how anesthetics and techniques related to anesthesia affect the microcirculatory system.

In addition to surgical patients, obstetric and trauma patients, as well as patients with chronic pain, epidural anesthesia is a common regional anesthetic technique. The physiological effects of epidural anesthesia are well-described, particularly the effects on cardiopulmonary and splanchnic at the macro and microcirculatory levels of epidural blockade. Both healthy volunteers and surgical patients experience decreased systolic and diastolic blood pressures during Thoracic Epidural Anesthesia (TEA). In canine models, TEA improved regional cardiac blood flow to benefit the endocardium. The complicated effects of epidural anesthesia on gastrointestinal perfusion are one important question that is currently being investigated in both clinical and experimental studies.

Microcirculatory Effects of Epidural Anesthesia

The degree of blockage and the dose at which TEA interrupts sympathetic activity are related to mesenteric venodilatation. Mesenteric venoconstriction caused by an increase in splanchnic sympathetic activity is demonstrated by epidural blockade that is only applied to the lumbar segments. Major surgical procedures, pain, or shock states may cause gastrointestinal hypoperfusion by increasing sympathetic nervous system activity. As a result, the primary hypothesis that has been investigated in recent years is that the response to stressful stimuli during TEA is influenced by a reduced sympathetic nervous system. TEA improved microcirculatory perfusion and increased gastrointestinal blood flow in animal studies. OPS imaging revealed improved gastric microcirculation following esophagectomy, as demonstrated by a previous TEA study on dogs. After the procedure, gastric and intestinal mobility improved. In rats, TEA decreased intermittent flow in the villous microcirculation while increasing blood flow to the ileal mucosa. Because of the technical aspects of splanchnic blood flow assessment in clinical practice, clinical study results are less consistent. Only indirect methods, like gastrointestinal tonometry or measuring proinflammatory mediators and circulatory vasoactive substance release, are possible, with the exception of the intraoperative period. During bowel surgery, intraoperative laser Doppler flow analysis revealed that TEA patients had a 41% increase in colonic blood flow. Mean colonic serosal blood flow, on the other hand, decreased by 65 percent in a different study that employed the same assessment method. There is growing evidence that TEA has beneficial effects on microcirculation and splanchnic blood flow in animal models of epidural anesthesia. Conflicting results have been obtained from recent clinical studies focusing on splanchnic perfusion under TEA, probably as a result of different assessment methods for splanchnic perfusion and different anesthetic and study protocols. There is also evidence that the systemic effects of absorbed local anesthetics may partially mediate the microcirculatory effects of neuroaxial blockade.

Endothelins and proinflammatory cytokines, including TNF, are released as part of the humoral response to CPB. An adverse perioperative outcome has been linked to these bioactive molecules. Endothelin blockers, or "suntans," have been developed for cardiovascular intervention because endothelins have diverse cardiovascular effects mediated by -receptors (vasoconstriction and negative inotropy). Examples include the nonselective blocker bosentan and the -blockers sitaxsentan and ambrisentan for the management of pulmonary arterial hypertension.

Perioperative Endothelin Blockade

A recent clinical study tested the biologically important hypothesis that endothelin-receptor blockade would affect the TNF response elicited by exposure to CPB during adult cardiac surgery because of cross-talk between the endothelin-receptors and TNF. If this hypothesis is true, then there is a possibility that TNF inhibition might increase the benefits of endothelin blockade for perioperative outcomes. On separation from CPB, 44 adult cardiac surgical patients were randomly assigned to receive either a placebo or endothelin-receptor blockade with sitaxsentan. The main finding was that TNF activation was significantly reduced after 24 hours when endothelin-blockade was present. Additionally, higher sitaxsentan doses were associated with greater TNF suppression, which was dose-dependent. After CPB, this RCT has demonstrated a potential clinical interaction between endothelin and cytokine pathways. To find out if endothelin blockers like sitaxsentan significantly improve outcomes following cardiac surgery with CPB, additional trials need to be adequately powered.

Intriguingly, patients with aortic stenosis have significantly increased endothelin-receptor activity, which encourages aortic valve leaflet inflammation and fibrosis. Endothelin blockade should be looked at as a medical option to stop or slow the progression of aortic valve stenosis, just like statins are.

In-hospital mortality, myocardial infarction, and pulmonary and renal complications were significantly linked to inadequate blood glucose control. The prevalence of mortality was as follows: 1.8% in the favorable group, and 4.2% in the moderate group (moderate vs. favorable control: 1.68 odds ratio; 95% confidence interval, 1.25-2.25), while 9.6% were in the poor group (poor vs. good control: 3.90 odds ratio; 2.47 to 6.15, 95% confidence interval). The researchers came to the conclusion that half of the patients whose perioperative blood glucose control was inadequate were not known diabetics. Because inadequate glucose control is a distinct predictor of in-hospital mortality and morbidity, this observation is crucial.

There is still insufficient evidence to recommend surgical treatment for significant secondary MR, as reflected in the most recent guidelines for valvular heart disease in the United States and Europe. In high-risk groups with significant MV disease, transcatheter mitral techniques may expand treatment options. Although transcatheter devices are based on surgical MV repair principles, they now include edge-to-edge leaflet approximation, leaflet resection, neochordal construction, annuloplasty, and a family of randomized trials with defined endpoints. The MitraClip device (Abbott, Abbott Park, IL), which is based on the surgical edge-to-edge repair (Alfieri stitch) and is currently undergoing feasibility trials, has been extensively utilized, with over 19,000 applications worldwide. In 2013, the MitraClip device received commercial approval in the United States after being evaluated in a randomized trial for degenerative magnetic resonance (MR).