Abstract
There are many questions facing cardiac anaesthesiologists today. In general terms, one aims to protect organ function while exposing the patient to the necessary cardiopulmonary bypass (CPB). Some of these issues will be considered.

Cerebral protection
Brain injury is a very difficult entity to try to deal with in the cardiac surgical patient. The pathophysiology of brain injury is believed to arise from both emboli (macro- and micro-emboli) and hypoperfusion with subsequent inflammation of neuronal tissue. This phenomenon is, by its nature, multifactorial and, therefore, difficult to manage by manipulating any one factor.

The incidence of brain injury varies with both the timing and nature of the investigation. Diffusion weighted magnetic resonance imaging (MRI) has demonstrated infarction in up to 45% of patients postoperatively. On the other side of the coin, cognitive dysfunction may not be significantly different if cardiac surgery patients are compared to their unoperated controls.

Cerebral perfusion pressure
Only one single, small study suggests that higher perfusion pressures are desirable. Gold et al examined mean arterial pressure (MAP) targets of 50 - 60 mmHg, compared to 80 - 100 mmHg, and found a reduced combined incidence of stroke and myocardial infarction with higher perfusion pressures. It is, therefore, the practice of many units to use higher perfusion pressures in older, high risk patients.

Cerebral oxygen delivery: haematocrit
While there is a relationship between severe haemodilution and stroke, there is no single haematocrit value which can be used as a threshold. The Society of Thoracic Surgeons Blood Conservation Guideline Task Force recommends blood transfusion at a threshold of 6 g/dl while on bypass, and 7 g/dl after weaning from bypass.

Temperature management
With the exception of deep hypothermic circulatory arrest, hypothermia during CPB cannot reliably be shown to result in cerebral protection, despite the obvious beneficial effects of hypothermia on the brain. A possible reason for this is the nature of central rewarming, which itself causes cerebral hyperthermia. The current recommendations would be to closely monitor nasopharyngeal temperature for hyperthermia and consider stopping rewarming at 34 - 35°C.

Glycaemic control
Recent publications have challenged the use of tight glycaemic control in critically ill patients, even in cardiac surgical patients who stay in the ICU for several days. In addition, tight glycaemic control intra-operatively (5.3 vs. 10.6 mmol/dl) has been associated with higher risk of the composite outcome of death, myocardial infarction, renal failure and stroke. However, gross dysglycaemia should not be tolerated, either because of the associated immune and osmotic effects.

Off-pump coronary bypass
Avoidance of CPB by performing off-pump surgery remains an attractive concept in attempting to reduce neurological complications. While the current prospective studies do not support this, studies of high risk patients are not yet available.

Corticosteroid use
Corticosteroids have both genomic and non-genomic anti-inflammatory effects and are known to ameliorate the response to CPB. Various clinical outcomes have been investigated in cardiac
surgical patients. Studies in this area are difficult to analyse due to variability in agent and dose used. Outcomes which may be affected include reduced bleeding and length of stay in ICU and hospital.

Two large studies (aiming to recruit more than 14 000 patients) are currently underway. In meta-analysis, the single outcome which is significant is the incidence of atrial fibrillation.

**Atrial fibrillation**

Atrial fibrillation is a common complication of all thoracic surgery, and is related to inflammatory burden, myocardial oedema and fluid overload, among others. Given in appropriate doses, corticosteroids have been shown to reduce the incidence of atrial fibrillation by as much as 50%. Interestingly, both very high dose and low dose steroids do not appear to have this effect.

**Conditioning the myocardium**

There are a great many pharmacological agents which have pre-conditioning effects. Two which are easy to consider in this context are volatile anaesthetic agents and opioids. This will be explored in the lecture.

**Volatile conditioning**

In this debate, there are still more questions than answers. Meta-regression and meta-analysis have both shown improved morbidity and mortality associated with the use of volatile anaesthetic agents in patients undergoing coronary bypass surgery. Single studies, however, are contradictory. The potential effects of volatile agents are even less clear in patients undergoing valve replacement. Additional questions include the best agent to be used, and the dose and duration of exposure necessary to achieve the desired effects.

**Opioids**

Delta opioid receptor agonism has been associated with improved ischaemic pre-conditioning. Different opioids have different affinities for opioid receptors, with morphine specifically having significant delta opioid affinity. This is interesting in light of retrospective data demonstrating improved outcomes in patients where morphine was favoured over fentanyl in cardiac surgical patients.

References available from the author.