

## **Cardiothoracic Anaesthesia - New developments and current thinking.**

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There have been a number of significant developments within the fields of cardiac surgery and interventional cardiology which have impacted upon cardiac anaesthesia in the past year or so. Some of these developments which may be relevant to the non cardiac anaesthetist are summarised by other lecturers at this symposium e.g. ischaemic and pharmacological myocardial preconditioning and advances in cardiovascular monitoring to mention but two. I will therefore deal with the following specific areas.

- Advances in valve replacement and percutaneous coronary interventions.
- Advances in transfusion medicine – lessons learnt from cardiac surgery.
- Advances in cardiopulmonary bypass.

### **Advances in percutaneous valve and coronary interventions.**

Both percutaneous coronary stenting and valve replacement are examples of innovations that change long established practice and are collectively known as “disruptive technologies”.

Transcatheter aortic valve replacement is a developing management strategy<sup>1</sup> for high risk elderly patients with aortic stenosis and has developed from lessons learnt from the percutaneous pulmonary artery replacement program in children with congenital defects. A number of commercially available devices are undergoing trials around the world. The placement of such devices can be achieved either by a transfemoral or a transapical approach the latter being favoured in individuals with extensive aorto-iliac disease<sup>2-4</sup>. Due to its more complex architecture the development of a percutaneous approach to surgery of the mitral valve has been more protracted. Open mitral valvotomy for severe mitral stenosis was a common procedure prior to the advent of cardiopulmonary bypass this has been superseded by percutaneous balloon valvuloplasty. More recently a percutaneous approach to mitral valve repair has been described and animal studies have been undertaken looking at a variety of approaches to percutaneous mitral valve replacement as a redo procedure. In many cases this has involved a “valve in valve” placement in which the transcatheter valve is implanted within an existing deficient prosthetic valve. The rationale for this approach is that the existing prosthetic annulus acts as a framework to support the new valve upon deployment. Although transcatheter technology is still in early development the combination of these technologies with advances in endovascular stenting of the thoracic aorta and enhanced imaging e.g. intracardiac and 3D echocardiography, opens up new vistas for the invasive management of intrathoracic cardiovascular problems.

The relative value of percutaneous versus surgical revascularisation for coronary artery disease remains contentious<sup>5</sup>. Percutaneous coronary interventions have developed from simple balloon angioplasty, followed by the introduction of a succession of strategies to reduce restenosis rates starting with bare metal stents, moving on to drug-eluting stents - which reduce the neointimal response by the slow release of antiproliferative drugs - to bioabsorbable drug-eluting coronary stents. The continuing presence of the framework of the stent following drug elution prevents adequate repair of the artery and is thought to be the major reason behind the enhanced risk of stent thrombosis. Research has established that once an artery has healed there is no further requirement for this neointimal suppression, drug-eluting bioabsorbable stents support a vessel, preventing neointimal

proliferation during the healing phase following angioplasty but are subsequently reabsorbed minimising the risk of stent thrombosis<sup>6</sup>. Other potential advantages include the ability to utilise non invasive imaging modalities of coronary arteries e.g. CT and MRI as well as improving surgical access should open heart surgery be required at a future date.

### **Advances in transfusion medicine – lessons learnt from cardiac surgery.**

Cardiac surgery has always been a major user of blood and blood products, the requirements for both resulting in part from the physiological upset caused by the response to extracorporeal circulation and the necessity for systemic anticoagulation. Haematological management of the perioperative period has been a long time interest of the cardiac anaesthetist. Many of the lessons learnt have been transferred into the wider world of anaesthetic practice e.g. pharmacological manipulation of coagulation systems, cell salvage and transfusion triggers and point of care testing for coagulation deficits facilitating targeted product replacement.

In the first two of these there have been significant developments in 2008. There has always been a concern over the safety profile of Aprotinin, particularly in respect of graft occlusion following CABG. A much debated study<sup>7</sup> published in 2006 suggested an adverse outcome for CABG patients treated with Aprotinin, a further highly damaging study in 2008 indicated that death rates in high risk surgical case treated with Aprotinin were greater than those in a cohort where the drug was not used<sup>8</sup>. The adverse outcomes from this and other trials published in 2008 led the manufacturers to withdraw marketing of the drug and a renewed interest in lysine analogues<sup>9</sup> generating much debate within the world of cardiac anaesthesia.

The storage lesion effects resulting from the storage and subsequent retransfusion of blood components are well known. The significance of these effects has not always been fully evaluated; however a recent study<sup>10</sup> has shown an enhanced propensity to adverse outcomes in patients receiving blood transfusion during the course of cardiac surgery. This has further enhanced the debate upon perioperative transfusion triggers in cardiac surgery. Current practice is based upon absolute values e.g. 6g/dL, however logic dictates that percentage falls from baseline should be considered to be a more appropriate trigger and there is now good outcome evidence to support this rationale<sup>11</sup>.

### **Advances in cardiopulmonary bypass.**

Traditional cardiopulmonary bypass (CPB) is largely based upon techniques developed over 30 years ago. Similarly the adverse effects of CPB both physiologically, neurologically etc have been well documented. The desire to reduce these side effects has led to the development of off-pump cardiac surgery (OPCAB) for coronary artery revascularisation and more recently mini-bypass which allows for intracardiac procedures to be undertaken. These low volume circuits utilise vacuum venous drainage, low volume centrifugal pumps and no reservoir. Early experience with these systems suggest that there is a learning curve to their use which requires close cooperation of perfusionist, anaesthetist and surgeon to ensure minimal risk to the patient in particular from arterial air embolisation. The potential benefits of the use of such circuits include a reduction of sheer forces on blood cellular components, reduced haemodilution and retransfusion of cardiotomy reservoir blood, improved biocompatibility and a reduction in the systemic inflammatory response to bypass. Although many of these physiological outcome improvements have already been demonstrated questions still remain as to whether this will transcend into improved clinical outcomes<sup>12</sup>.

