Monitoring physiological parameters has changed the face of anaesthesia. We have become accustomed to the safety margins that the pulse oximeter, capnograph, non-invasive blood pressure (BP) and electrocardiogram (ECG) leads provide us, especially in the supine position. However, it is a changing science as new monitoring systems come into the market, and as such, we have to adjust our anaesthetic techniques in order to provide the safest anaesthetic for our patients, especially if it is performed on patients in unusual positions.

Shoulder surgery, especially arthroscopic work, is frequently performed in the beach chair position (BCP).

There are definite advantages to positioning the patient in this somewhat cumbersome position. These are:

- Excellent intra-articular visualisation;
- Ease of conversion to an open approach if needed;
- Reduced brachial plexus strain as no traction is used.

Unfortunately, there are disadvantages that need to be managed:

- Decreased blood pressure;
- Decreased venous return resulting in hypotensive, bradycardic episodes;
- Decreased cerebral perfusion;
- Increased risk of perioperative cerebral ischaemia/stroke;
- Positional obstruction of internal jugular veins leading to impaired cerebral drainage.

Blood pressure is the product of systemic vascular resistance (SVR) and heart rate (HR). Most people are able to compensate for the drop in BP that is experienced when changing from a horizontal to a vertical position by increasing the systemic vascular resistance by 50-80% when unanaesthetised. Anaesthesia obtunds this autonomic response with vasodilating agents. Added to the myocardial depressant effects of the anaesthetic agents, is the decrease in venous return caused by the upright positioning. This underfilling of the ventricle can lead to activation of the Bezold-Jarisch reflex which leads to hypotensive bradycardic episodes. Pre-emptive management with elastic stockings and calf compressive devices has been shown to decrease the incidence of these episodes.
Symptomatic management with fluid, vagolytic agents and vasopressors has also been shown to be helpful in the prevention of progression to asystolic cardiac arrest.

The second cause of hypotension is iatrogenic and deliberate in that a bloodless field gives the surgeon a clearer view for the surgery. This is frequently requested by the surgeon.

Cerebral perfusion pressure (CPP) is the difference between mean arterial pressure (MAP) and intracranial pressure (ICP), or central venous pressure (CVP), whichever is the higher, i.e. CPP = MAP-ICP or CVP. Cerebral blood flow (CBF) is protected by autoregulation, which is generally considered to function with MAP values of between 50-150 mmHg. However, below this, CBF becomes dependent on MAP. An individual's lower limit of autoregulation may have shifted to a higher value by underlying co-morbidities, which may or may not have been diagnosed, or which may not be adequately managed.

All patients will inevitably have non-invasive BP monitoring on the upper arm, but this in no way represents the BP at watershed areas of the brain as the BP decreases by 1 mmHg for every 1.25 cm above the NIBP cuff, due to gravity. Put another way, this means that for every centimetre above the NIBP cuff, the pressure decreases by 0.8 mmHg. This can be accommodated for by measuring the distance between the NIBP cuff and the frontal cortex and multiplying it by 0.8 to get an accurate value for the MAP at a watershed area of the brain. Alternatively, it can be done by placing an arterial line (A-line) in the radial artery on the nonoperative side and placing the bridge at the level of the frontal cortex. A-lines are not without their hazards and patients should provide informed consent as to the risks involved. There are no definitive guidelines stipulating who should definitely have an A-line placed and there is no justification in placing A-lines in all patients. Patients who are elderly, or those with co-morbidities, should, I feel, have an A-line placed after checking for adequate flow in the ulnar artery on that side and after getting informed consent from the patient.

The danger of hypotension is clear. A case series of four patients was published in the Journal of Clinical Anaesthesia in 2005 and highlighted the need for not overestimating the CPP. All four patients were low risk and all ended up in a vegetative state following devastating neurological damage post hypotensive shoulder surgery in the beach chair position. None of them had A-lines placed as they were all healthy individuals, and none were over 60 years old.

So where do we go from here? Near-infrared spectroscopy has been around for a few years, but is traditionally used in cardiac and vascular surgery, as well as neurosurgery. In South Africa, the monitor that is available is in vivo optical spectroscopy (INVOS).

Two probes are placed on the forehead, one above each eyebrow. This gives an estimate of the cerebral oxygenation of the frontal cerebral cortex, a watershed area which may therefore act as an early warning system for more global brain hypoxia. The system is based on the ability of light to penetrate the skull and determine the haemoglobin oxygenation according to the amount of light absorbed by the haemoglobin. In each probe is a light source. Unlike pulse oximeters, there are two photo-detectors in each probe that allow for selective sampling of tissue beyond a specified depth beneath the skin.

The near-field photo-detection, which comprises surface data from the skin and skull, is subtracted from the far-field photo-detection to minimise superficial signal contamination and results in an oxygenation value specific to the deeper tissues under the probe. The tissue sampling mostly represents venous blood (75%), with sampling of the arterial blood making up the difference and is therefore not reliant on pulsatile flow. The value is presented as a number out of 100, with different values for the left and right sides of the brain. There is also a graphical representation on the monitor.

Essentially, if the number drops, it is because demand is outstripping supply. This becomes dangerous if it drops to < 20% of the baseline value, which is taken prior to anaesthesia, on room air.

Reasons for a drop in the cerebral oxygenation are:

- Hypotension;
- Vasoconstriction;
- Anaemia;
- Increased viscosity of the blood.
The management arms are thus aimed at correcting underlying problems. Hypotension is the most common culprit in surgery on the beach chair, but others must be considered if the value remains low despite adequate management of the hypotension. A unilateral decrease on either the right or the left side is indicative of decreased supply to that side and one should first check to ensure the head is positioned in the midline, to exclude kinking of the underlying vasculature as the cause. Other rarer possibilities, such as air embolism from the surgical site, or a thrombotic or haemorrhagic vasculature insult should also be considered.

Who should use INVOS in the beach chair position? The probes are non-invasive and do not contain latex. They are expensive (currently in the region of R1 850 for the two) and, although some medical aids see the benefit of adequate neurological monitoring in a potentially hazardous situation, others do not, and thus careful discussion with all patients is warranted. The major benefit is that INVOS individualises the patient's response to the BP supplied to their brain. Therefore, if an individual's lower limit of autoregulation for CPP has been raised, there will be no danger of missing that important fact. A good idea of how to respond adequately for that individual is obtained, as well as the benefit of seeing whether the assumed cause, and therefore management, was indeed correct.

A study published in August 2010 in Neuroscience in Anesthesiology and Perioperative Medicine showed that the number of cerebral desaturation events (CDEs) was significant in the beach chair position, far more than in the alternative position used in shoulder arthroscopy surgery, i.e. the lateral decubitus, and that the use of a near-infrared spectroscopy (NIRS) system was beneficial in the identification and management of these events.

Further studies are underway to look at this, but the emerging support in favour of using this monitor in the beach chair is growing, and I think it is our ethical duty to use whatever we can to prevent catastrophic neurological events in our patients, especially with regard to what should be uneventful and routine surgery.

Bibliography