

*Vascular Anaesthesia Society  
of Great Britain and Ireland*

*Annual Scientific Meeting*

*Abstracts for  
London Meeting*

*11th & 12th September 2017*

*The Institution of Engineering  
and Technology (IET)  
2 Savoy Place  
London  
WC2R 0BL*

# VASCULAR ANAESTHESIA SOCIETY

Monday 11<sup>th</sup> September 2017

## Session 1: Rambo First Blood

- 11.15 - 11.40      **"NOACS – Non-Vitamin K Antagonist, Oral Anticoagulants"**  
Dr Martin Besser, Cambridge
- 11.40 - 12.05      **"Update on Transfusion Strategies in Vascular Patients – CAVIAR, PREVENTT "**  
Dr Andrew Klein, Papworth
- 12.05 - 12.30      **"Patient Blood Management in Vascular Surgery"**  
Dr Fateha Chowdhury, London

## Session 2: The Patient with Renal Failure – Urine Trouble

- 1.45 - 2.10      **"The Vascular Patient and Renal Dysfunction, including the Pathophysiology of AKI "**  
Dr Andrew Lewington, Leeds
- 2.10 - 2.35      **"Renal Protection: Myth or Reality?"**  
Dr Gudrun Kunst, London
- 2.35 - 3.00      **"Management of Anaesthesia for Renovascular Access in the Patient with ESRF"**  
Professor Marc Clancy, Glasgow

## Session 3: Amputation, the deepest Cut

- 3.45 - 4.10      **"Perioperative Management for Lower Limb Amputation"**  
Dr Chiara Tosini & Dr Aoife Hegarty, London
- 4.10 - 4.35      **"Rehabilitation Following Amputation"**  
Professor Rory O'Connor, Leeds
- 4.35 - 5.00      **"Informed Consent for High Risk Surgery/amputation"**  
Mr Bertie Leigh, London

# VASCULAR ANAESTHESIA SOCIETY

Tuesday 12<sup>th</sup> September 2017

## Session 4: Endovascular Surgery: One More with Feeling!

- 9.00 - 9.25            **"Teacups and Talking to Chimps: Performance Under Pressure "**  
Dr Guy Sanders, London
- 9.25 - 9.50            **"Endovascular Surgery – Recent Developments, New Devices and what they can do for us"**  
Mr Peter Holt, London
- 9.50 - 10.15           **"Complex Endovascular Surgery"**  
Professor Ian Loftus, London

## Session 5: Research and Audit

- 11.00 - 12.00           **Free Paper Session**
- "Could transcranial magnetic stimulation reliably be used as an intra-operative monitor of spinal cord function during thoraco-abdominal aortic aneurysm repair surgery? A pilot study in healthy volunteers"**  
*Pawandeep Sarai, Imperial College Healthcare NHS Trust*
- "Using local survival data to more accurately guide decision making in abdominal aortic aneurysm surgery"**  
*John Whitaker, Sheffield Teaching Hospitals*
- "Clinical Quality Improvement Project (QIP): The Road to Recovery Programme"**  
*Heena Bidd, Guys' and Saint Thomas' Hospital*
- "Patient Blood Management in Vascular Surgery: A Retrospective Cohort Study"**  
*Christine Sathanathan, Royal Free Hospital London NHS Foundation Trust*
- "The rating of perceived exertion is sensitive but not specific for identification of a maximal CPX test"**  
*Christopher Jones, St James' University Hospital, Leeds*
- 12.00 – 12.45           **Case Based Discussion – "Management of Ruptured Aortic Aneurysms.**  
Professor Ian Loftus, London  
Mr Peter Holt, London  
Dr Jelena Devic, London

## Session 6: Before we go! CPD Session

- 1.45 - 1.55            **Prize Presentations**  
Dr Simon Howell, Leeds
- 1.55 - 2.20            **"Perioperative Management of Patients with Pulmonary Hypertension"**  
Dr Alex Dewhurst, London
- 2.20 – 2.45            **"Perioperative Management of the Diabetic Patient; Reducing Complications"**  
Dr Grainne Nicholson, London
- 2.45 – 3.10            **"Carotid Endarterectomy, The Head or the Heart"**  
Dr Indran Raju, Glasgow

## **"NOACS – Non-Vitamin K Antagonist, Oral Anticoagulants"**

*Dr Martin Besser, MRCP FRCPath  
Consultant Haematologist  
Addenbrooke's and Papworth Hospital UK*

Direct Oral Anticoagulants (DOACs) have revolutionised treatment of VTE and AF but pose new challenges in terms of bridging therapy for elective and emergency surgery and monitoring.

This talk summarizes what we know about their action, elimination and the current best guidance regarding bridging, monitoring while comparing and contrasting this with Vitamin K antagonists

# "Pre-operative anaemia - diagnosis and treatment in vascular patients"

*Dr Andrew Klein  
Consultant Anaesthetist  
Papworth Hospital, Cambridge, UK  
Editor-in-Chief, Anaesthesia*

Learning objectives:

- Definition of anaemia
- Scale of the problem
- Causes of anaemia
- Diagnosis
- Treatment

Summary:

This talk will define anaemia in the context of pre-operative optimisation before surgery and discuss the scale of the problem. Up to 40% of patients presenting for surgery may be anaemic, and this is increasingly common as patients are getting older and sicker. We are facing an epidemic of anaemia, but, in many centres, patients are not investigated nor treated. There is marked regional variation in both anaemia and transfusion, with a consistently high incidence of both. Peri-operative anaemia, blood loss and allogeneic blood transfusion are associated with increased postoperative morbidity and mortality, and prolonged hospital stay. A multidisciplinary, multimodal, individualised strategy, collectively termed 'patient blood management', may reduce or eliminate allogeneic blood transfusion and improve outcomes. This approach has three objectives: the detection and treatment of peri-operative anaemia; the reduction of peri-operative bleeding and coagulopathy; and harnessing and optimising the physiological tolerance of anaemia.

There are numerous causes of anaemia in surgical patients, the most common is iron deficiency or iron restriction. Pre-operative anaemia is associated with increased mortality and worse outcomes, including increased transfusion and complications. Anaemia should be detected before surgery that is likely to cause significant blood loss, preferably at least 30 days before scheduled operations. The cause of pre-operative anaemia should be identified and treated if possible. Bleeding from the GI tract and the genital-urinary system should be considered and investigated. Major surgery may have to be rescheduled, whereas minor procedures, without blood loss, can proceed in parallel with the evaluation of anaemia. Different treatment options will be discussed and compared in both elective and urgent surgery. Optimising patients with anaemia before surgery may reduce allogeneic transfusion and improve outcomes as part of a comprehensive blood management programme, and this forms a vital part of peri-operative patient care. This lecture will also update about ongoing research including PREVENTT and CAVIAR.

References

Muñoz M, Acheson AG, Auerbach M, et al. International consensus statement on the peri-operative management of anaemia and iron deficiency. *Anaesthesia* 2017; 72: 233–47.

Klein AA, Collier T, and the Association of Cardiothoracic Anaesthetists (ACTA). The incidence and importance of anaemia in patients undergoing cardiac surgery in the UK – the first ACTA national audit. *Anaesthesia* 2016; 71: 627–35.

Musallam KM, Tamim HM, Richards T, et al. Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study. *Lancet* 2011; 378: 1396-407.

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Partridge J, Harari D, Gossage J, Dhesi, J. Anaemia in the older surgical patient: A review of prevalence, causes, implications and management. *Journal of the Royal Society of Medicine* 2013; 106: 269-77.

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Clevenger B, Mallett SV, Klein AA, Richards Y. Patient blood management to reduce surgical risk. *British Journal of Surgery* 2015; 102: 1325-37.

Litton E, Xiao J, Ho KM. Safety and efficacy of intravenous iron therapy in reducing requirement for allogeneic blood transfusion: systematic review and meta-analysis of randomised clinical trials. *British Medical Journal* 2013; 347: f4822.

## **"Acute Kidney Injury in the Vascular Patient"**

*Dr Andrew Lewington  
Leeds Teaching Hospitals NHS Trust*

The presentation will review the current consensus definition of acute kidney injury (AKI) as proposed by the international guideline body Kidney Diseases: Improving Global Outcomes (KDIGO). This will be framed in the clinical relevance of AKI in the current health care setting. The focus will be on AKI in surgical patients and will cover the pathophysiology of AKI. There will be a focus on incidence of AKI in patients undergoing vascular surgery to include cardiac surgery. Proposals will be made regarding identifying patients at risk of AKI and the current preventative strategies that are available. There will be discussion of the results of more recent trials of AKI biomarkers and the outcomes of remote ischaemic preconditioning in preventing AKI.

## "Renal Protection – Myth or Reality?"

*Gudrun Kunst*

*Consultant Anaesthetist*

*King's College Hospital NHS Foundation Trust, London*

Acute kidney injury (AKI) after general surgery is a serious complication. In cardiovascular surgery the incidence is up to 38% [1,2] and it is associated with increased postoperative morbidity, length of hospital stay and a 12-fold increase in the relative risk of in-hospital or 30 day mortality [3].

Since 2004/2005 AKI is defined according to the RIFLE (Risk, Injury, Failure, Loss of kidney function and End-stage kidney disease) criteria [4]. An important aspect for renal protection after surgery is the early diagnosis of AKI. Serum Creatinin (sCr) is a biomarker of renal function and not specifically of renal injury. Therefore, there is a significant time lag of at least 24-48hrs between kidney injury and loss of kidney function, which results in rising sCr levels [5]. In addition, the concentration of sCr can be variable and is dependent on age, muscle mass, gender and medications. This is a missed opportunity for treatment during a window of opportunity at 4-12hrs after kidney injury, which may contribute to the high morbidity and hospital mortality of patients with AKI. Recent renal injury markers that may rise within 4-12hrs after AKI include neutrophil gelatinase-associated lipocalin (NGAL), kidney injury molecule-1 (KIM-1), interleukin-18, cystatin C and insulin-like growth factor-binding protein 7 (IGBP7) and tissue inhibitor of metalloproteinase-2 (TIMP-2). These markers are sensitive but not always kidney specific.

Potential treatment options that will be explorable after an early postoperative diagnosis of AKI include postoperative interventions aimed at reducing the deterioration of AKI.

According to the KDIGO recommendation [6], multimodal kidney protective interventions include discontinuation of nephrotoxic agents, optimisation of volume status and perfusion pressure, consideration of functional haemodynamic monitoring, close monitoring of sCr and urine output and avoidance of hyperglycaemia. In addition to this multimodal KDIGO kidney protective strategy, many additional preventive and therapeutic interventions have been assessed in single-centre proof-of-concept trials. However apart from positive results, there have also been a number of negative reports and these interventions have therefore been discussed controversially. They include pharmacologic agents, remote ischaemic preconditioning and early renal replacement therapy (reviewed in [7]).

In summary, perioperative AKI is common, occurring in about 1/3 of patients after cardiac or vascular surgery resulting in significant increases in postoperative morbidity and mortality. In order to provide renal protection with the application of a bundle of renal protective interventions, early renal injury markers will be necessary. Perioperative renal protection is a vision, which should include a multi modal approach for perioperative renal protection strategies. So far small single centre proof of concept trials have shown benefit, and larger multicentre studies need to further explore renal protection in the future.

### References

1. Hausenloy DJ, Candilio L, Evans R, et al. Remote Ischemic Preconditioning and Outcomes of Cardiac Surgery. *The New England journal of medicine* 2015; 373: 1408-17.
2. Dariane C, Coscas R, Boulitrop C, et al. Acute Kidney Injury after Open Repair of Intact Abdominal Aortic Aneurysms. *Ann Vasc Surg* 2017; 39: 294-300.
3. Singri N, Ahya SN, Levin ML. Acute renal failure. *JAMA* 2003; 289: 747-51.
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5. Pickering JW, Endre ZH. Bench to bedside: the next steps for biomarkers in acute kidney injury. *Am J Physiol Renal Physiol* 2016; 311: F717-F21.
6. Kellum JA, Lameire N, Group KAGW. Diagnosis, evaluation, and management of acute kidney injury: a KDIGO summary (Part 1). *Crit Care* 2013; 17: 204.
7. Meersch M, Schmidt C, Zarbock A. Perioperative Acute Kidney Injury: An Under-recognized Problem. *Anesthesia and Analgesia* 2017.



**"Randomised controlled trial of Supraclavicular brachial plexus block versus local anaesthetic in the formation of arteriovenous fistulae for dialysis"**

*Professor Marc J Clancy  
Consultant Transplant Surgeon  
Queen Elizabeth University Hospital Glasgow  
Honorary Associate Professor, University of Glasgow*

It is rare in clinical care that the exact anaesthetic technique makes a substantial difference to the clinical outcome in surgical terms. Arteriovenous fistula formation is key to effective delivery of haemodialysis through the avoidance of indwelling vascular catheters. This trial compared regional anaesthesia (supraclavicular brachial plexus block) with local anaesthesia for fistula formation and demonstrated a very interesting improvement of outcomes with the regional technique. The implications for future practice will be discussed.

## **"Perioperative Management of Lower Limb Amputation"**

*Dr Chiara Tosini  
Consultant Anaesthetist in Vascular Anaesthesia  
St George's Hospital*

*Dr Aoife Hegarty  
Fellow in Vascular Anaesthesia  
St George's Hospital*

Major lower limb amputation is a high-risk procedure with a high post-operative morbidity and mortality. Approximately 1 in 5 adults greater than 55 years of age in Europe and North America have peripheral arterial disease (PAD).<sup>1</sup> This amounts to 500-1,000 patients per million of the UK population with clinically significant PAD, of whom 1-2% will eventually require amputation.<sup>1</sup> Another concerning factor is the global increase in incidence of diabetes mellitus. This will contribute to a large increase in incidence of critical limb ischaemia in the years to come, which will have a significant impact on society and on our healthcare systems.

In this presentation we discuss facts and figures regarding major lower limb amputation in recent years, the most recent guidance available for management of these patients<sup>2</sup> and evidence to support use of the different modes of anaesthesia and analgesia available in the peri-operative period.

### References:

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[www.ncepod.org.uk/2014lla.htm](http://www.ncepod.org.uk/2014lla.htm)

VSGBI – A Best Practice Clinical Care Pathway for Major Amputation Surgery – April 2016. Available at:

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## **"Teacups and Talking to Chimps: Performance Under Pressure"**

*Dr Guy Sanders  
Consultant Trauma Anaesthetist  
St George's Hospital, London*

This presentation examines what medicine can learn from professional sport and performance psychology in maximising performance when the pressure is on. It will consider the value of simulation, the dangers of binary decision making, the importance of cognitive appraisal and the effect of stress on cognition.

**"Endovascular Surgery – Recent Developments, New Devices and what they can do for us"**

*Mr Peter Holt  
St Georges Hospital, London*

Endovascular techniques are now in predominance worldwide for the treatment of aortic pathologies. New approaches to arterial access, and to the junctional regions of the aorta have made surgery possible for a greater number of patients with more complex aortic morphologies. The advent of branched and fenestrated technologies, and parallel grafts, has changed the treatment of the visceral aorta in particular. This talk will review some of those advances and discuss where challenges remain to be addressed.

## "Complex Endovascular Surgery"

*Professor Ian Loftus  
Professor of Vascular Surgery  
St George's NHS Trust, London*

Early experiences of thoracic endografting were in patient deemed unfit for open surgery. The high rates of complication and mortality from open repair are well documented, with only the very highest volume centres achieving good clinical outcomes, especially in unfit patients. With increased experience of endovascular intervention, and the publication of large series documenting high technical success rates, with complication rates which compare favourably with open repair, so an endovascular approach has become the treatment of choice for many aortic specialists.

This has brought different challenges. Endovascular repair requires a healthy 'landing zone' proximally and distally, to allow for secure device fixation and robust long term durability. This can sometime require compromise in terms of the use of devices, coverage of branches, or revascularisation of branch vessels. It can also preclude some patients from endovascular intervention all together, especially related to the size of thoracic endograft delivery devices. Furthermore, the thoracic aorta poses very different haemodynamic and anatomical challenges compared to the infra-renal aorta.

The thoracic aorta is also susceptible to a variety of pathologies that are quite different to the spectrum of disease encountered in the abdominal aorta. This includes thoracic trauma (aortic transection), acute aortic syndromes (including aortic dissection, penetrating ulcers and intramural thrombus), as well as aneurysmal degeneration. Each of these conditions must be considered differently in terms of endovascular approach, perioperative risk and long term surveillance.

Across all aortic pathologies, early series demonstrated technical success rates of 97% or higher, and mortality rates of around 5%. They also recognise the additional risk of stroke and paraplegia of around 5% each- though the absolute risk of these catastrophic complications varies depending on the aortic pathology and other factors.

Over the last 10 years we have made significant progress in understanding the prediction, prevention and management of thoracic pathologies and the associated complications. Much of this comes from analysis of large scale registry data, including the MOTHER registry. This includes when and how to revascularise the left subclavian artery, should coverage be required to achieve device fixation, and the management of spinal risk including the use of spinal drains. These will be discussed in detail during the presentation.

### Key references

- 1) Volodos NL et al. Clinical experience in the use of self expanding synthetic prostheses for aorta reconstruction. *Vasa* 1991; 33:93-5.
- 2) Dake M et al. Transluminal placement of endovascular stent grafts for the treatment of descending thoracic aortic aneurysms. *N Eng J Med* 1994;331:1729-34.
- 3) Lears LJ et al. Endovascular treatment of thoracic aortic disease, Combined experience of EUROSTAR and UK. *J Vasc Surg* 2004;40:670-80.
- 4) Patterson BO et al. Management of the left subclavian artery and neurologic complications after thoracic endovascular aortic repair. *J Vasc Surg*. 2014 Dec;60(6):1491-7.
- 5) Patterson BO et al. Aortic pathology determines midterm outcome after endovascular repair of the thoracic aorta: report from the Medtronic Thoracic Endovascular Registry (MOTHER) database. *Circulation* 2013; 127(1):24-32.

## **"Perioperative Management of Patients with Pulmonary Hypertension"**

*Dr A T Dewhurst MBBS, FRCA, FICM.  
Consultant in Intensive Care and Anaesthesia.  
St George's Hospital, London, UK.*

Pulmonary Hypertension (PH) is defined as a mean pulmonary artery pressure (mPAP) of greater than or equal to 25mmHg measured using a right heart catheter (RHC). It is classified into 5 groups;

1. Pulmonary Arterial Hypertension (PAH)
2. PH secondary to left heart disease (PH-LHD)
3. PH secondary to lung disease (PH-lung)
4. Chronic Thromboembolic PH (CTEPH)
5. Miscellaneous

PH has a prevalence of 3-120 per million and is associated with a perioperative morbidity of 14-42% and mortality of 1-18%.

It has been described as a disease with multiple aetiologies leading to a common haemodynamic state rather than a single entity. A distinction should be noted between the clinical picture seen in PAH and other types of PH. A degree of reversibility is possible. Different clinical classifications demonstrated different characteristic histological arteropathies. These may account of the variation in the severity of haemodynamic disturbance.

Diagnosis and preoperative assessment should include; ECG, CXR, PFT, ABG, Echocardiography and consideration of CTPA and RHC. Treatment can be considered in terms of supportive, general and specific therapy. Specific therapy for PAH is usually initiated at a regional specialist PH center. There are three molecular pathways that can be targeted. Prostaglandins, Endothelin-1 receptors and endogenous Nitric Oxide. Surgical pulmonary endarterectomy maybe offered to suitable patients with CTEPH. Lung transplantation is an option in a limited number of cases.

Anaesthetic management aims to optimize the preoperative physiological state of the patient and minimize cardiovascular disturbance during surgery. The choice of anaesthetic technique is less important than the manner in which it is conducted. Following surgery patients should be cared for in a high dependency unit (HDU). Manipulation of the cardiovascular system during surgery and in the post operative period aims to; optimize right ventricular (RV) preload, reduce RV afterload, maintain perfusion pressure and improve RV contractility.

In summary severe PAH is a rare condition but PH-LHD and PH-lung are commonly seen by anaesthetists. PH is associated with increased morbidity and mortality. Optimal preoperative care, careful intraoperative management and care on an HDU in the postoperative period may reduce complications.

References:

1. Anaesthesia 2015, 70, 56-70, S A Pilkington

## **“Perioperative Management of the Diabetic Patient; Reducing Complications”**

*Dr Grainne Nicholson  
Senior Lecturer and Honorary Consultant  
St George's Hospital NHS Trust, London*

Diabetes mellitus (DM) is the most common metabolic disorder and in the United Kingdom; 6-7% of the population are diabetic. The prevalence is expected to increase rapidly over the next decade as a consequence of obesity, lack of exercise, increased migration of susceptible patients and an ageing population. Type 2 diabetes accounts for about 90% of patients with DM. As the prevalence of DM increases so the number of diabetic patients requiring surgery will increase. Surgery is often undertaken for the complications of DM such as peripheral vascular disease, coronary artery disease and renal failure but diabetes may be unrelated to the surgical procedure.

Diabetic patients presenting for surgery are challenging because of their diabetes and the risks of hypo- and hyper-glycaemia. Metabolic control is an issue including the risks of in-hospital diabetic keto-acidosis, complications of VRII (variable rate insulin infusion), and electrolyte abnormalities. Patients are usually taking multiple medications with the potential for drug administration errors. They are at an increased risk of infection risk and are prone to cardiovascular disease (macro and microvascular disease), renal disease and neuropathy.

Prevention of perioperative complications relies on meticulous pre-operative assessment, awareness of the risk of complications, and an anaesthetic technique which minimises metabolic disruption. The type, duration and current treatment of DM must be ascertained and a recent HbA1C estimation will show the adequacy of glycaemic control in the previous 2-3 months. The following basic investigations should be undertaken in all diabetic patients: blood glucose concentration, urinalysis for albumin and ketones, haemoglobin, blood urea, creatinine and electrolytes and ECG. Further investigations are determined clinically.

Intraoperatively control of blood glucose in the surgical diabetic patient is complicated by several factors. Preoperative starvation should be minimised and after surgery the early resumption of oral intake enables the diabetic patient to return to their usual treatment regimen. The prevention and prompt treatment, if necessary, of postoperative nausea and vomiting is a vital part of perioperative care. The endocrine and metabolic response to surgery further complicates glucose control. Catabolic hormone secretion increases blood glucose and in diabetic patients with no or impaired endogenous insulin, there are no metabolic constraints on the hyperglycaemic effects of these hormones. Anaesthetic drugs may influence the glucose response to surgery in diabetic patients by decreasing catabolic hormone secretion (regional anaesthesia and opioids) or inhibiting any residual insulin secretion (volatile anaesthetics). The aims of metabolic management are to avoid hypoglycaemia, excessive hyperglycaemia and to minimise lipolysis and proteolysis by the provision of exogenous glucose and insulin as necessary.

Studies of the potential benefits of glucose control in diabetic surgical patients have been triggered by studies in critically ill patients in the past decade. In cardiac surgery there is evidence to suggest that intraoperative and postoperative control of blood glucose with insulin in diabetics and non-diabetics improved morbidity, particularly the incidence of postoperative wound infections. Until recently there are few studies examining the effects of glucose control in diabetic patients undergoing general surgery, but an increasing number of studies in patients undergoing general, orthopaedic and vascular surgery suggest that maintaining normal blood glucose complications reduces the risks of wound infection and improves morbidity and mortality. Rather than aiming for “tight” control, a range of 6-10mmol L<sup>-1</sup> has been proposed as a pragmatic approach. There is no evidence that any particular anaesthetic technique is safer; both regional and general anaesthesia have inherent risks and benefits. There is however, evidence that over-enthusiastic use of the variable rate insulin infusion (VRII) has been associated with significant complications including hypoglycaemia.

Postoperatively, Encourage earlier mobilisation with resumption of normal diet and return to usual diabetes management. The patient should resume diabetes self-management as soon as possible where appropriate. Multi-modal analgesia should be combined with appropriate anti-emetics to enable an early return to normal diet and usual diabetes regimen.

References:

Nicholson G, Hall GM. Diabetes and adult surgical inpatients. *Continuing Education in Anaesthesia, Critical Care & Pain* 2011;11: 234-238.

Dhatariya K1, Levy N, Kilvert A et al; Joint British Diabetes Societies. NHS Diabetes guideline for the perioperative management of the adult patient with diabetes. *Diabet Med.* 2012; 29:420-33.

Association of Anaesthetists of Great Britain and Ireland. Peri-operative management of the surgical patient with diabetes. *Anaesthesia* 2015; 70: 1427-1440



## FREE PAPER SESSION

### **“Could transcranial magnetic stimulation reliably be used as an intra-operative monitor of spinal cord function during thoraco-abdominal aortic aneurysm repair surgery? A pilot study in healthy volunteers.”**

*Pawandeep Sarai*

*Imperial College Healthcare NHS Trust*

Paraplegia following thoracoabdominal aortic aneurysm (TAAA) repair surgery is a devastating complication, effecting up to 16.5% of patients (1). Current methods of intra-operative spinal cord monitoring utilise somatosensory evoked potentials (SSEPs) or muscle motor evoked potentials (MEPs) generated by transcranial electric stimulation (TES). Although these methods can detect ischaemic spinal cord injury (ISCI), they are not without their disadvantages. SSEPs have a high false negative rate and do not interrogate the corticospinal tracts. TES is invasive and involves the exogenous application of large electric currents, causing intense pain, restricting its use to anaesthetised patients. Since 5-11% of ISCI occurs post-operatively (2), there is a need for a reliable and tolerable peri-operative monitor of spinal cord function. Transcranial magnetic stimulation (TMS) produces currents within the brain via electromagnetic induction using a small hand-held coil placed over the motor cortex, which produces a MEP in the electromyogram recorded from muscles. It is a non-invasive, non-painful tool for monitoring neural pathways with comparable results to TES and hence could be used detect ISCI.

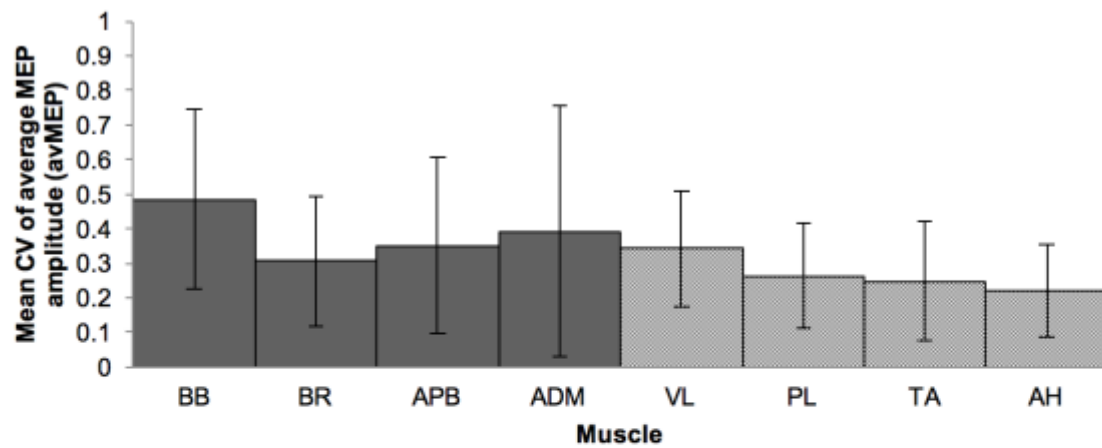
The aim of this study is to determine the variability of TMS-induced MEPs from a variety of upper and lower muscles at rest. 20 volunteers (8 females, age 23-55yrs) were recruited. TMS was applied using two different types of magnetic coil held over the vertex. Trains of 6 stimuli were delivered to target upper limb muscles (biceps brachii (BB), brachioradialis (BR), abductor digiti minimi (ADM) and abductor pollicis brevis (APB)); trains of 6 stimuli to target lower limb muscles (vastus lateralis (VL), peroneus longus (VL), tibialis anterior (TA) and abductor hallucis brevis (AHB)) every 10 minutes for 1 hour. MEPs were recorded using surface electromyography. The 6 stimuli were averaged and amplitudes and latencies measured. The data were subsequently analysed and statistical analysis performed.

The upper limb muscle with the largest mean MEP amplitudes across all time points was APB ( $1.92 \pm 0.17$  mV (mean  $\pm$  SD)). The lower limb muscle with the largest mean MEP over all time points was AHB ( $1.06 \pm 0.04$  mV). The least variable upper limb muscle across 1 hour was BR (coefficient of variation (CV) = 0.31) and the least variable lower limb muscle was AH (CV = 0.22). Lower limb muscles demonstrated lower variability (see fig 1), although there was no significant difference between the overall CVs of upper and lower limb muscle mean MEP amplitudes. Across all muscles and time points, MEP latency showed minimal variation. APB and AHB latency showed the least variation, with a CV of 0.029 and 0.025, respectively.

TMS-induced MEPs from a variety of muscles were found to have low variability over time. Our results suggest that TMS could be used as a potentially reliable intra-operative monitor of spinal cord function in TAAA surgery. We recommend APB (control muscle) and AHB (monitor muscle) in a TMS-based monitor of spinal cord function due to their large mean amplitudes and their ease of access during surgery. The next stage of this project is to investigate the effects of limb ischaemia and anaesthesia on TMS-induced MEPs in patients undergoing vascular surgery; to date, no research has been undertaken in this area.

#### References

1. Bicknel C, Powell JT. Heart 2015; 586-91
2. Lancaster RT, Conrad MF, Patel VI, Cambria MR, Ergul EA, Cambria RP. J Vasc Surg 2013



**Fig. 1. Mean ( $\pm$ SD) CV of average MEP amplitudes for 4 upper (black bars) and 4 lower limb (grey bars) muscles.**

Mean coefficient of variation of avMEP over all time points in each muscle is shown (biceps brachii (BB), brachioradialis (BR), adductor digiti minimi (ADM), abductor pollicis brevis (APB), vastus lateralis (VL), peroneus longus (VL), tibialis anterior (TA) and abductor hallucis (AH)). No significant difference was found between muscle variability. The data demonstrates that lower limb muscles generally have a lower mean CV of avMEP amplitude than upper limb muscles.

## **“Using local survival data to more accurately guide decision making in abdominal aortic aneurysm surgery”**

*John Whitaker  
Sheffield Teaching Hospitals*

Patients and clinicians need an accurate assessment of the risks before deciding between options for repair of an abdominal aortic aneurysm (AAA). The EVAR-1 trial provided evidence to recommend open or endovascular repair (EVAR) to patients based on predicted survival(1). The third treatment option of conservative management is often neglected in studies. There can also be significant population differences between centres, possibly affecting the point at which this decision sways in favour of EVAR or open repair(2). We therefore have looked at our own data to provide more locally specific guidance to our decision making.

This was a retrospective observational study on 1233 patients attending for elective AAA management between November 2005 and January 2017. Data was divided into open repair, EVAR, conservative management and other interventions (primarily aortobifemoral bypass). Data was recorded in Microsoft Excel and analysed with the R statistical software performing univariate analysis using a COX model.

There were 480 deaths in our cohort and a median survival of 6.59 years. Median survival for open repair was 9.22 years with no survival difference versus EVAR at 7.90 years (HR 1.029, CI 0.772-1.373,  $p=0.846$ ). The other management strategies were associated with a significantly reduced survival, being 2.55 years for conservative management (HR 4.317, CI 3.443-5.412,  $p<0.001$ ) and 7.51 years for other interventions. (HR1.733, CI1.174-2.557,  $p=0.006$ ).

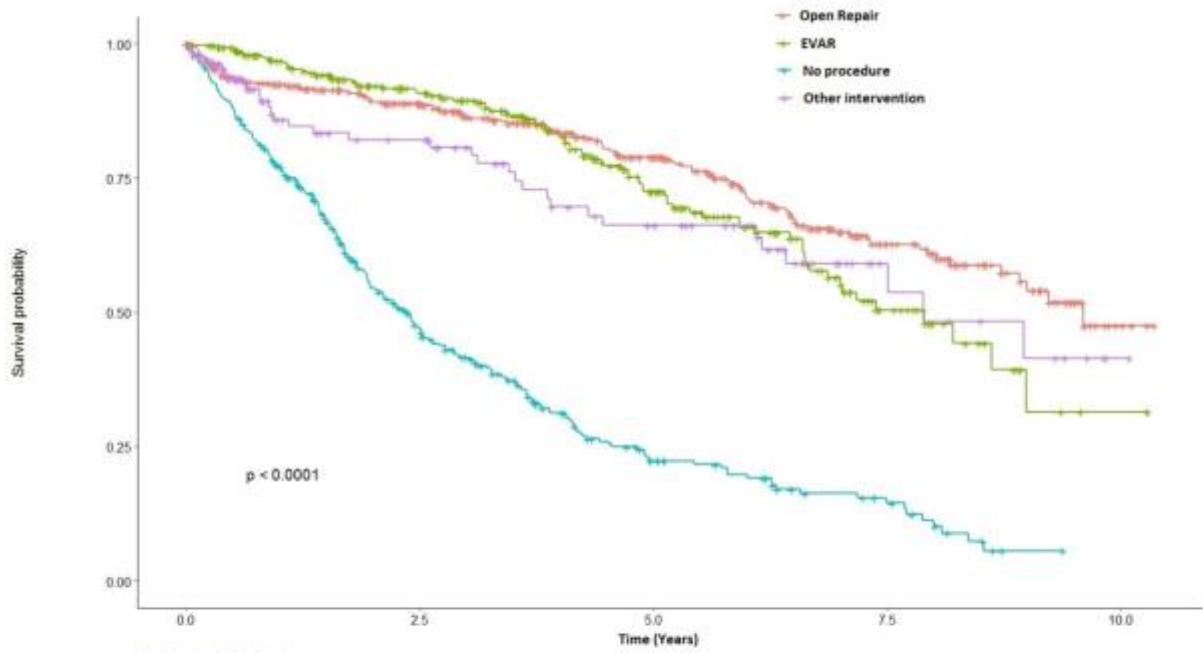
A Kaplan-Meier estimate of our data is in Figure 1. Survival for EVAR falls below that for open repair approximately 4 years post procedure. The conservative cohort shows approximately 25% mortality at one year and 50% mortality at 2.5 years. We can also see that initial <1 year mortality in the 'other aortic interventions' group is essentially the same as open repair but in the mid-term (beyond 1 year) the mortality is greater.

Our results agree with the EVAR 1 trial with no long term survival benefit between EVAR and open repair. The point of convergence of the open and EVAR survival curves is at four years in our centre compared with two years in the national data suggesting that our patients experience more benefit from EVAR than elsewhere. The high postoperative mortality in the 'other intervention' group reflects the co-morbidity of these patients, who mostly had occlusive aortic disease suggesting severe atherosclerosis. They are therefore are a higher risk group even when compared to other aneurysm surgery. Mortality rates in the conservative management cohort raise some interesting issues. Some of these deaths will be aneurysm-related but it is likely that the majority of these patients were risk stratified to a group for whom intervention was not beneficial due to co-morbidity. Had they been operated on, some of these patients would have had a death attributed to surgery rather than background high year on year mortality, emphasising the importance of accurate risk assessment.

Overall our data suggests that survival profiles in our centre differ from nationally. Given the importance of accurate assessment and discussion of risk between patient and clinicians we would recommend that centres analyse their own data and use this to guide local decision making.

### References

1. Patel, R., Sweeting, M., Powell, J., & Greenhalgh, R. (2016). *Lancet*, (10058), 2366-2374.
2. Carlisle, J. B., Danjoux, G., Kerr, K., Snowden, C., & Swart, M. (2015). *Anaesthesia*, (6), 654-665



Number at risk by time

Strata	0.0	2.5	5.0	7.5	10.0
Open Repair	429	305	196	75	4
EVAR	303	205	102	26	2
No procedure	360	134	40	15	0
Other intervention	141	62	37	11	1

Time (Years)

## **“Clinical Quality Improvement Project (QIP): The Road to Recovery Programme”**

*P Banugo, H Waring, M Fuller, Liana Zucco, H Bidd, St. Thomas' Hospital, London  
Heena Bidd, Guys' and Saint Thomas' Hospital*

To pilot a prehabilitation workshop and home-based preoperative exercise programme on patients awaiting open or endovascular abdominal aortic aneurysm (AAA) repair and lay the foundations for a prehabilitation service within the Trust and assess compliance to the programme and the effect of preoperative exercise on functional capacity.

With an ageing population, we are now treating greater numbers of patients who are frail. These ‘high-risk’ patients, owing to significantly impaired functional capacity, are at substantial risk of postoperative morbidity and mortality. Optimising patients’ fitness prior to surgery, otherwise known as Prehabilitation, has the potential to offset the increased risk [1]. Lifestyle modification e.g. smoking cessation, nutrition and anxiety reduction form part of a multimodal prehabilitation strategy. A growing body of evidence suggests that such a strategy can improve postoperative outcome, reducing length of stay, postoperative pain and postoperative complications.

There is a growing need to improve outcomes in vascular surgery, yet few examples of vascular prehabilitation programmes exist. At St. Thomas’ Hospital, we set up the Road to Recovery programme to assess the feasibility of a home-based prehabilitation service for patients awaiting elective repair of open or endovascular aortic abdominal aneurysms.

A survey was conducted to evaluate interest in patients awaiting open or endovascular AAA repair for a preoperative exercise programme. Patients were invited to attend a two hour, interactive group workshop on the same day as their surgical consultation. Key elements of the physiotherapist/anaesthetist-led workshop:

- Education on aneurysm pathology, lifestyle modifications and the patient journey
- Participation in a short physiotherapist-led exercise class
- Assessment of baseline functional capacity using gait speed and Timed up and Go (TUAG)
- Provision of a 6-week exercise programme and Diary Cards to record activity

Feedback on the usefulness of the workshop was obtained via questionnaire. Following the exercise programme, functional capacity reassessments are made.

Of the 31 patients that responded to the survey, 87% felt it was important to get fit prior to major surgery. Approximately 50% of respondents were happy to commit to an exercise regime, the other 50% were unsure but none of the respondents were against taking part in a preoperative exercise programme. To date, 25 patients have attended the Road to Recovery workshop for which the feedback has been very positive (see Table 1). As patients complete their exercise programmes we will be able to assess adherence and effect on functional capacity. There is an appreciation amongst vascular patients that being fit prior to undergoing major vascular surgery is important. Furthermore, patients are willing to engage in education and lifestyle modifications that may potentially improve their chances of a good postoperative recovery.

We aim to improve the robustness of our existing process through funding for the group workshops and the use of wearable technology to track fitness activity and compliance to the programme.

1.Snowden CP, Prentis J, Jacques B et al. Cardiorespiratory fitness predicts mortality and hospital length of stay after major elective surgery in older people. *Ann Surg.* 2013 Jun; 257 (6): 999-1004

Table 1. Workshop feedback

Patient	Comment
1	Keep up the hard work
2	Music
3	No due to everything satisfactory. Everything was very well explained, operating procedure, before op and also post op, fitness and also how to build muscle tone do's and don'ts
4	You are doing fine, well done
5	Exercise
6	Builds confidence and makes me feel a part of my procedure
7	Positive thinking, information helpful. Confidence building
8	I understand that a stent will be placed – re-guiding the blood supply
9	Very satisfied. Nothing to improve
10	Very interesting
11	
12	Good. All good to know
13	Always room for improvement but at present we are very impressed
14	Workshop covered lower aneurysm but didn't really cover upper thoracic aneurysm. Helpful all the same
15	
16	
17	Very useful information + exercises
18	Very useful, found all useful.
19	Very helpful for my prep and recovery, just keep doing what you guys do best :)
20	Good work from staff
21	Very helpful and reassuring
22	A good informative session, maintain what you are already doing
23	
24	Expectations of recovery times

# “Patient Blood Management in Vascular Surgery: A Retrospective Cohort Study”

*Christine Sathananthan*  
*Royal Free Hospital London NHS Foundation Trust*

Preoperative anaemia is a risk factor in cardiac and non-cardiac surgery for multiple adverse outcomes. However, in vascular surgery, the interplay between preoperative anaemia and receiving perioperative transfusions on adverse postoperative outcomes has not been well established. We aimed to assess the effect of preoperative anaemia and perioperative transfusion on prolonged length of stay, 30-day readmission, in-hospital and longer term mortality risk. Patient Blood Management (PBM) is patient-orientated concept applying evidence-based best practice aiming to improve patient outcomes and safety by avoiding unnecessary blood transfusions and optimising the requirement and use of blood component transfusion[1]. The “three pillar” strategy of PBM in the surgical setting strategy (detecting perioperative anaemia, minimising perioperative blood loss, and optimising patient’s physiological reserve of anaemia) was implemented in our institution in 2015. As a secondary aim, we evaluated the use of blood transfusion in vascular surgery at Royal Free Hospital (RFH) after a 6 month PBM initiative in 2015.

Data was analysed on all patients undergoing vascular surgery at RFH between 2012 and 2016. The administrative and pathology databases were electronically linked to obtain admission data, demographics, laboratory results and blood components orders. Multivariate logistic regression analysis was used to assess the crude and adjusted effect preoperative anaemia (defined according to the World Health Organisation (WHO) criteria: Male Hb <130 g/L and Female <120 g/L) had on postoperative outcomes including in-hospital, 30, 90 and 180 day post-operative mortality.

Of 1552 patients included in the final analysis; mean ( $\pm$  SD) age was 70.3 ( $\pm$  12.9), 486 (31.3%) were female and 815 (52.5%) had preoperative anaemia. Overall 366 (23.6%) had blood transfusion. Preoperative anaemia was significantly associated with higher odds of perioperative transfusion, postoperative length of stay over 7 days and 30-day postoperative accident and emergency visit (Adjusted OR (95% CI): 4.32 (3.17-5.88), 1.70 (1.30-2.23) and 1.72 (1.20-2.47) respectively,  $p < 0.001$ ). The effect of pre-operative anaemia on mortality shows a statistically significant mortality risk throughout the perioperative period: A significant decrease in rate (29.6% in 2012 to 16.5% in 2016,  $p = 0.001$ ) and average units of red blood cells and platelet use (mean ( $\pm$  SD)) of 1.8 ( $\pm$  4.6) in 2012 to 0.8 ( $\pm$  3.6) in 2016,  $p = 0.002$  was observed. Postoperative haemoglobin transfusion trigger was lowered from an average 76.3 ( $\pm$  10.1) g/L in 2012 to 71.8 ( $\pm$  8.8 g/L) in 2016 ( $p < 0.001$ ). A decreased rate of LOS > 7 days ( $p = 0.024$ ) was observed in the same time period.

Preoperative anaemia is associated with adverse postoperative outcomes in vascular surgery. It is a risk factor for prolonged in-hospital length of stay, 30-day readmission, in-hospital and longer term mortality. These effects appear to be partly mediated by a requirement for transfusion. Future studies involving large cohorts with a randomised controlled design are needed to effectively examine these multiple relationships. Implementation of PBM in the Vascular Surgical unit at RFH has shown initial success. However, improvements in screening of preoperative anaemia are needed to broaden the scope and potential impact of PBM on this and other populations.

## Reference

1. Shander A, Van Aken H, Colomina MJ, et al. Br J Anaesth 2012;109(1):55-68

Mortality type	Adjusted† Odds Ratio (OR) [95%CI] , p-value
In-Hospital	2.11 (1.12-4.0), p<0.001***
30 - day	2.02 (1.17-3.50), p<0.05**
90 - day	1.84 (1.17-2.90), p<0.01*
180 - day	2.47 (1.67-3.66), p<0.001

† Adjusted for age, sex, admission type (elective vs. emergency or urgent) and type of procedure  
P-values calculated from z test. \*\*p<0.05; \*p<0.01; \*\*\*p<0.001.



## **“The rating of perceived exertion is sensitive but not specific for identification of a maximal CPX test”**

*Christopher Jones  
St James' University Hospital, Leeds*

Cardiopulmonary exercise (CPX) testing is commonly used in pre-operative assessment as a non-invasive method of assessing physiological reserve and predicting the peri-operative and post-operative risk to patients. Outputs of CPX tests are dependant on the level of exertion. Recorded observations of patient exertion during CPX testing are not widely documented in all the pre-operative testing literature. This service evaluation used the Borg rating of perceived exertion (RPE) scale to determine the proportion of CPX tests conducted to a) maximal perceived exertion, b) maximal physiological criteria, and to c) assess the agreement between the two.

57 surgical patients undergoing CPX testing as part of a pre-operative assessment were asked to score their exercise intensity at the point of CPX test termination using a Borg RPE scale. A RPE of 17 is the highest level of activity possible for a healthy person to sustain.(1, 2) The concordance between RPE and maximal CPX tests was evaluated using a kappa test. Achievement of one of the following physiological criteria determined a maximal test: a respiratory exchange ratio (RER)  $\geq 1.05$ ,  $\geq 80\%$  peak predicted heart rate, a breathing reserve  $< 11$  L/min or a visualised plateau of oxygen consumption (VO<sub>2</sub>). (3, 4)

17 maximal tests were based solely on an RER  $\geq 1.05$ , 16 maximal tests were based solely on a peak predicted heart rate  $\geq 80\%$  and four maximal tests were based solely on a breathing reserve  $< 11$  L/min. For the remaining maximal tests, patients achieved multiple physiological criteria.

VO<sub>2</sub> plateaus were observed in only five patients, who rated their exertion as 18, 20, 17, 17, and 19 on the Borg scale.

Overall there was poor agreement between ‘maximal’ CPX tests based on physiological criteria and ‘maximal’ CPX tests based on RPE, kappa(95% CI) = 0.093(-0.123 to 0.308).

In CPX testing literature there is some variation in the RER considered to identify a ‘maximal’ exercise test. A post-hoc analysis using a raised RER criterion ( $\geq 1.10$ ) identified 14 maximal CPX tests based on a RPE  $\geq 17$ . Sensitivity and specificity of using an RER cut-off  $\geq 1.10$  to determine a maximal CPX test based on RPE  $\geq 17$  were 66.67% (95% CI = 43-85%) and 40% (95% CI = 24-58%) respectively, compared to 80.95% sensitivity (95% CI = 58-95%) and 27.78% specificity (95% CI = 14-45%) using an RER  $\geq 1.05$ .

The majority of CPX tests are maximal on the basis of physiological criteria. The Borg RPE scale maps poorly on to physiological criteria for a maximal CPX test. Post-hoc analysis suggests a closer relationship between RPE and physiological criteria if the RER cut-off for a maximal test is taken as 1.10.

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1. Borg G. Psychophysical bases of perceived exertion. *Med Sci Sports Exerc* 1982;14:377-381.
2. Edvardsen E, Hem E, Anderssen S. End Criteria for Reaching Maximal Oxygen Uptake Must Be Strict and Adjusted to Sex and Age: A Cross- Sectional Study. *PLoS One* 2014;9:e85276.
3. American Thoracic Society; American College of Chest Physicians ATS/ ACCP Statement on cardiopulmonary exercise testing. *Am J Respir Crit Care Med* 2003;167:211-277.
4. Fourman D, Myers J, Lavie C, et al. Cardiopulmonary exercise testing: relevant but underused. *Postgrad Med* 2010;122:68-86.

# VASCULAR ANAESTHESIA SOCIETY

## Poster Presentations

**Carotid endarterectomy under local anaesthesia: a systematic review of block type and associated intraoperative pain scores**

*Alex Coupland, Charing Cross Hospital*

**Vascular Anaesthesia Study and Simulation Day – A new course**

*Natalie Smith, Derriford*

**Mode of Anaesthesia for Endovascular Abdominal Aortic Aneurysm Repair - a Systematic Review**

*Peter Steed, Southmead Hospital*

**Preparedness for elective vascular surgery: comparing theatre direct admissions with ward admissions in a tertiary centre**

*Lance Holman, Oxford University NHS Foundation Trust*

**Hardman Score as a predictor of mortality in ruptured AAAs: Hardly worth it?**

*Harry Phillips, Royal Bournemouth Hospital*

**Rectus sheath catheters versus thoracic epidural in elective open abdominal aortic aneurysm (AAA) repair**

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**A Viewpoint into Theatre Efficiency within Vascular Surgery across London and South East England.**

*Katherine Grailey, Royal London Hospital*

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*John Whitaker, Sheffield Teaching Hospitals*

**Current Anaesthetic Practices for Elective Endovascular Abdominal Aneurysm Repair in a Tertiary Hospital in Singapore**

*Lim Ming Jian, Singapore General Hospital*

**Outcomes of Patients Undergoing Open Abdominal Vascular Operations Using Cell Salvage at The Queen Elizabeth University Hospital, Glasgow**

*Thomas Keast, Queen Elizabeth University Hospital*

**Should we be measuring Activated Clot Times in peripheral vascular surgical patients after heparinisation – an ongoing debate**

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**Major lower limb amputations; One year follow up in a regional vascular unit**

*Caroline Curry, Royal Victoria Hospital Belfast*

**Right or left arm non-invasive blood pressure measurement in vascular inpatients: does it matter?**

*Satinder Dalay, Birmingham Heartlands Hospital*

**Review of Maximum Surgical Blood Ordering Schedule for Elective Vascular Surgical Patients: Is our ordering excessive?**

*Alexandra Murphy, Royal Victoria Hospital*

**The changing face of perioperative care for endovascular aortic aneurysm surgery**

*Shamir Karmali, Northwick Park Hospital*

**Does peripheral nerve block improve outcomes in below knee amputations?**

*James Sylvester, Doncaster Royal Infirmary*

**Postoperative pain management in patients presenting for lower limb amputations. Audit of current practice in Tertiary referral centre**

*Anna Malik, St George's Hospital*

**Gaining Mastery in Vascular Anaesthesia-A Survey of Advanced Vascular Training**

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**Contrast induced acute kidney injury (CI-AKI) after endovascular aneurysm repair (EVAR): A tertiary referral centre's experience**

*Manik Chandra, Leeds General Hospital*

**Get It Right the First Time: Cardio-pulmonary Exercise Testing (CPET)**

*David Wotherspoon, Bedford Hospital*

**Use of Novel Aspects of Cardiopulmonary Exercise Testing to Predict Complication Type Following the Open Repair of Abdominal Aortic Aneurysm**

*Matthew D Walne, University of Sheffield*

**Post-Operative Health Related Quality of Life in Vascular Patients undergoing Complex Aortic Surgery using a novel SMS Patient Reported Outcome Measures Tool: A Service Improvement**

*Christine Sathanathan, Royal Free Hospital London NHS Foundation Trust*

**Post operative analgesic requirements and outcomes post complex aortic endovascular repair**

*Ciara I Donohue, Royal Free London*

# **Carotid endarterectomy under local anaesthesia: a systematic review of block type and associated intraoperative pain scores**

*Alex Coupland, Charing Cross Hospital*

## Introduction

Local anaesthesia for carotid endarterectomy is now well established as a safe and effective technique(1). For patients undergoing carotid endarterectomy intraoperative pain is often a concern and is discussed pre-operatively. A number of techniques are available for establishing regional anaesthesia. The aim of this systematic review is to consolidate current data on intraoperative pain and patient satisfaction scores during carotid endarterectomy under regional anaesthesia.

## Methods

Medline, Embase and PsychInfo were searched using combinations of the following search terms: pain; analgesia; anxiety; anaesthesia; anaesthetic; carotid endarterectomy and patient satisfaction. Studies were included if pain outcomes were reported and 2 or more methods for cervical plexus local anaesthetic blocks compared. The search identified 313 records, 259 after duplication. 73 full text articles were assessed; 9 met the inclusion criteria.

## Results

Of those studies that quantified and compared pain or satisfaction scores, 5/9 reported statistically significant improvements when a deeper block was used in comparison to a superficial block. 3 studies compared a superficial cervical plexus block with a combined cervical plexus block. 2 studies reported non-significant differences in pain scores between groups; both studies used 0.375% bupivacaine for the block. The study that reported a significant improvement in intraoperative pain scores used 0.5% bupivacaine and 2% lidocaine with epinephrine. Pain and satisfaction scoring systems are not standardised across studies.

## Conclusion

Pain and patient satisfaction data are currently lacking in studies that compare local anaesthetic techniques for carotid endarterectomy. Better data reporting and larger studies that compare block types will help to establish which techniques are best tolerated, with the lowest complication rates and which local anaesthetic agents give optimal results.

## Reference:-

1. Group GTC, Lewis SC, Warlow CP, et al. Lancet 2008; 372: 2132-42

## Vascular Anaesthesia Study and Simulation Day – A new course

*Natalie Smith, Derriford*

As a tertiary referral centre for vascular patients in the South West of England the vascular anaesthesia training module is compulsory at Derriford Hospital. We found that trainees were reporting difficulty in achieving adequate case mix, numbers and completing Work Place Based Assessments.

To assess current opinion an anonymous survey was sent to all anaesthetic registrars at Derriford Hospital. Of the fourteen respondents 35% reported their training in vascular anaesthesia to be inadequate/poor. No trainees reported their training to be excellent. The main criticisms included inadequate exposure to patients having a Carotid Endarterectomy (CEA) under regional anaesthesia (72%). 55% reported needing direct supervision when managing a CEA and 43% for a patient having an elective aortic cross clamp. 30% of our trainees reported having only been involved in at most one ruptured Abdominal Aortic Aneurysm (AAA), which they felt was inadequate for covering the senior oncall rota. Looking to improve on these results we found that 85% would attend a vascular training day. The most popular topics to be covered included; management of ruptured AAA, cross clamps and cervical plexus blocks.

We designed a specific vascular simulation training day aimed at registrars completing their intermediate training module. A variety of education techniques were chosen to enhance the learning experience including small group sessions, interactive lectures and simulation.

The day was attended by six registrars and was held in our simulation suite. The timetable included a lecture on CEAs and cervical blocks with an ultrasound session. A lecture on management of major limb amputations followed by an ultrasound session on popliteal catheter insertion. We simulated the theatre environment as closely as possible. Candidates were given a short introduction and assigned roles. The scenarios included a patient undergoing a CEA with regional anaesthesia who deteriorates and induction of a ruptured AAA.

To assess the day a questionnaire was completed by trainees before and after the training day. As part of the questionnaire a six point Likert scale was used. After the training day all trainees reported an increase, figure 1.

We noted an increase in confidence in all scenarios which were taught using interactive and simulated sessions. Preparing a patient and theatre for a ruptured AAA also showed a larger rise in confidence. This is a particularly important skill at an intermediate level as the trainee would be expected to prepare for the case without direct supervision.

We received excellent feedback at the debriefing session and from the questionnaire. Candidates commented on a 'good mix of lecture and simulation sessions' and felt the topics were 'relevant and informative'. To improve the course for the future, candidates suggested we include other practical sessions. They suggested sessions in setting up of the Belmont infuser and trauma lines. Other simulations to include scenarios with multiple outcomes and 'maybe invite our surgical colleagues' but recommended we keep the group numbers small. All candidates wrote that they would recommend the course to colleagues. We have reflected on the feedback, making alterations to future courses to include insertion of various wide bore lines. We will run the course biannually and it will be open to all South West Peninsula anaesthetic trainees.

# Mode of Anaesthesia for Endovascular Abdominal Aortic Aneurysm Repair - a Systematic Review

*Peter Steed, Southmead Hospital*

The endovascular revolution has changed the elective surgical management of patients with abdominal aortic aneurysms (AAA) and the indication from recent trials is that it will continue to be used more widely, including in the emergency setting for ruptured AAA (1). The lower mortality amongst patients undergoing emergency endovascular aneurysm repair (EVAR) treated under local anaesthesia (LA) from the IMPROVE trial (2) investigators sparked renewed interest in the existing controversy regarding the best anaesthesia choice for EVAR. This systematic review evaluates the effect of mode of anaesthesia on outcomes after EVAR.

The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines. The search terms local anaesthesia, regional anaesthesia, epidural, spinal, endovascular, surgery and the medical subject headings (MeSH) Spinal, Anesthesia, Epidural, Anaesthesia, Local, Endovascular Procedures, Aortic Aneurysm and Abdominal were used. The primary outcome was 30-day mortality, but the search was not restricted by outcome. Random effects meta-analyses were used to estimate the relative risk (RR) of death. Estimates from individual studies are unadjusted for potential confounding factors.

Our searches identified a total of 740 articles or abstracts. In total, 691 were excluded after two authors independently screened the abstracts, leaving 49 full-text articles, which were assessed for eligibility. Fifteen eligible studies in 27,004 patients were identified. None were randomized trials, all being classified as SIGN level 2 and therefore at risk of selection bias or confounding. 11/15 studies included only patients having elective EVAR, 3/15 included a mix of both elective and emergency EVAR and 1/15 focused exclusively on emergency EVAR. Details of the general anaesthesia (GA) technique used were described in 6 studies. Four studies used epidural anaesthesia, one used paravertebral blocks and 2 used a combination of spinal and epidural. The LA techniques described various doses of lignocaine and bupivacaine with monitored anaesthesia care and intravenous sedation. Reporting of results was variable and outcomes reported by mode of anaesthesia were very heterogenous. Nine studies in 10669 patients compared LA to GA and reported 30-day or in-hospital mortality. The unadjusted risk of death after EVAR with LA was lower than with GA (RR 0.55, 95% CI 0.36 to 0.85), but results were skewed by the IMPROVE trial, the only study that included only emergencies.

EVAR under LA is feasible, but there is limited evidence to suggest that LA is associated with improved outcomes after EVAR. Due to the absence of randomised trial data, significant risk of confounding remains. Randomised studies to compare LA to GA may be justified, especially in patients who present with ruptured AAA.

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## Preparedness for elective vascular surgery: comparing theatre direct admissions with ward admissions in a tertiary centre

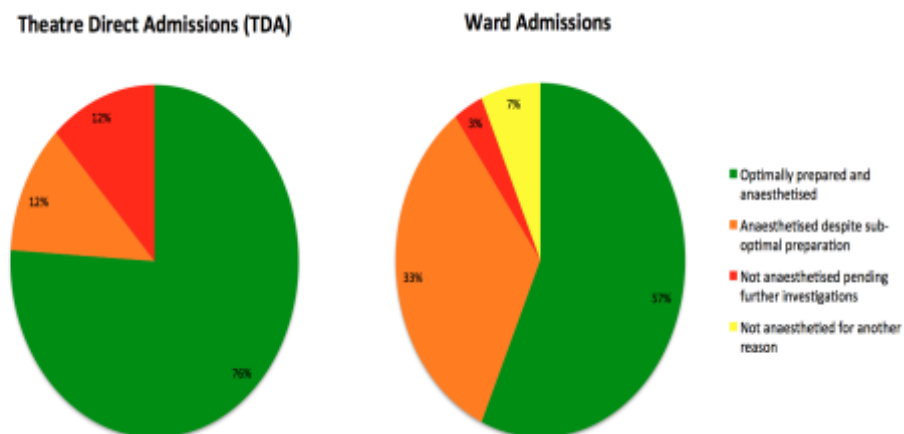
*Lance Holman, Oxford University NHS Foundation Trust*

Patients presenting for elective vascular surgery at our centre can be broadly categorised into those attending on the day of surgery via theatre direct admissions (TDA) and those admitted to the vascular ward the night before surgery. Broadly speaking, those presenting via TDA have been through the pre-assessment process, whereas those admitted the evening before are clerked by a junior doctor. Our aim was to assess whether there was a difference in the preparation and optimisation for surgery between these two groups.

A prospective audit was undertaken over a two month period. Data collection sheets were completed by anaesthetists for patients undergoing elective vascular surgery.

Of 55 patients undergoing elective vascular surgery, 25 were admitted directly to theatre (TDA) and 30 were admitted to the vascular ward the night before surgery (“ward patients”). 76% of TDA patients were optimally prepared for surgery, as compared to 57% in those admitted to the ward ( $p=0.13$ ). Suboptimal preparation for surgery was largely due to the omission of simple investigations or poor pre-operative medication management. 33% of ward patients were anaesthetised despite suboptimal preparation, compared to 12% of TDA patients ( $p=0.06$ ). Ward patients were more likely to introduce a delay to the operating list due to poor preparation (17% vs 8%,  $p=0.34$ ). TDA patients had a significantly shorter mean post-operative length of stay (2.32 vs 5.19 days,  $p=0.03$ ).

Although limited by the non-randomised, non blinded nature of the data, this audit suggests that patients admitted on the day of elective surgery after anaesthetic pre-assessment are better prepared than those admitted to the ward before surgery. Fewer delays were incurred and post-operative length of stay was shorter. To ameliorate this variation in outcome, a pre-theatre checklist is being introduced for use on the ward. This aims to ensure necessary investigations are completed and to avoid medication errors. Post-intervention data is expected by September. In time, and with engagement with both the surgical and management teams, it is hoped more patients will follow the pre-assessment/TDA pathway.





## **Hardman Score as a predictor of mortality in ruptured AAAs: Hardly worth it?**

*Harry Phillips, Royal Bournemouth Hospital*

The Hardman score was introduced in 1996 as a way to risk stratify patients who presented to hospital with a ruptured Abdominal Aortic Aneurysms (AAA). Previous historic studies have suggested that there is a strong correlation between a Hardman score over two, and mortality. The parameters include: Age > 76, serum creatinine > 190 umol/L, Haemoglobin (Hb) < 9 g/dL, myocardial ischaemia on ECG and a history of loss of consciousness after arrival to hospital. The Royal Bournemouth Hospital is a Regional Vascular Centre and is therefore referred ruptured AAAs from four local district general hospitals. We studied patients who presented to RBH over a 5 year period with ruptured AAAs to establish whether Hardman score correlated with mortality, or if there are any better prognostic indicators.

A retrospective analysis of notes of patients who presented with ruptured AAA from January 2010 to March 2017 was undertaken. The Hardman score was calculated and other variables such as age and blood loss were recorded. The data was then analysed using excel. We identified 119 patients who presented with ruptured AAAs to the emergency department during this time frame. A total of 95 patients had complete data. Fifty six (59%) patients survived their ruptured AAA, and thirty nine (41%) died. Seventy eight patients were operated on, with an operative mortality of 23/78 patients (29%) – nationally this is around 36%. The age range of patients was between 45 – 99.

From our data, a high Hardman score did not correlate with a poorer outcome. In fact, there were a number of patients who had a score of >3 who survived, and many with a score of <2 who had a poor outcome. There was a positive correlation between age and mortality and no patients in the >90 age group were deemed fit enough for an emergency repair. Initial Hb had no correlation with mortality; average Hb in those who survived and those who died was 113 g/dL in both groups. In line with national data indicating that creatinine is an independent predictor for mortality, we found patients with a creatinine > 170 umol/L had a higher mortality. Variables such as: number of red packed cells infused, ECG changes, history of loss of consciousness and operation length had no effect on mortality.

In conclusion, age was the most accurate predictor of mortality and was the most important factor when deciding whether to operate. High creatinine was also associated with a higher mortality. It is the author's view that Hardman score should be used with extreme caution, if at all as this had no correlation with mortality. Looking to the future, we hope to study a revised score which will include patient's age, creatinine, functional status and initial lactate.

### References:

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M. Gatt, M. Martinez, E.P. Perry, N. Barghouti. Do scoring systems help in predicting survival following ruptured abdominal aortic aneurysm surgery? Surgeon, 3 (Suppl) (2005), p. 68

## **Rectus sheath catheters versus thoracic epidural in elective open abdominal aortic aneurysm (AAA) repair**

*Esme Sleaf, Southampton General Hospital*

Rectus sheath catheters (RSC) are increasingly used as an alternative to thoracic epidurals (TE) in surgery requiring laparotomy (1,2). Epidurals provide excellent pain relief and are opiate sparing, but can be technically challenging and are associated with hypotension, motor block, and the possibility of serious complications. RSC have been demonstrated to provide analgesia comparable to TE (3) and avoid several of the risks and side effects. They are also useful where TE fails or is contraindicated. Studies have compared RSC and TE in colorectal, urology and gynaecology surgery (1-3), but not, to our knowledge, in open AAA repair. In our centre, both RSC and TE are used in this setting at the discretion of anaesthetist and surgeon, providing an opportunity to compare the two techniques.

A 3 year retrospective case note review was undertaken of patients who had elective open AAA repair at Southampton General Hospital from 2014-16. Patients either received TE, or RSC inserted at the end of surgery by the surgeon. RSC were loaded at the end of surgery by the surgeon, and then infused continuously with bupivacaine. All RSC patients also received patient controlled analgesia (PCA). Not all TE patients had a PCA. High care admission post operatively was routine. Outcomes recorded were pain scores in recovery, 6, 24 and 48 hours, length of high care and hospital stay, vasopressor requirement, nausea/vomiting, ileus, respiratory complications and time of first mobilisation.

88 patients underwent open elective AAA repair in this period. Having excluded those who had both RSC and TE, neither, or were kept intubated post operatively, we were able to review the notes and electronic records of 61 patients. 57.3% of patients had TE, 42.6% had RSC. Full results are shown in Table 1. Pain scores were generally low, with few patients in either group having moderate or severe pain. More patients in the RSCs group had no pain at 24 and 48 hours compared with the TE group. Length of stay, respiratory complication and ileus incidence were very similar between the two groups. Patients in the TE group stayed an average of 12 hours longer in high care, and required vasopressors more commonly - 77.1 v 26.9%. Nausea and vomiting was recorded more commonly in the RSC patients – 26.9 v 5.7%.

This observational study indicates that RSC and PCA is a reasonable alternative to TE for analgesia in patients undergoing elective open AAA repair, with similarly low pain scores in both groups. As expected, TEs were associated with hypotension requiring vasopressors. This may explain why RSC patients left high care an average of 12 hours earlier and mobilised slightly earlier. The fact that RSC patients had more nausea and vomiting is presumably due to higher opiate consumption, an outcome not recorded in this study. We acknowledge that pain is a difficult outcome to measure, and were slightly surprised that pain scores were so low, when the narrative in the notes sometimes suggested otherwise. This work may act as a pilot for a larger, prospective study, which should include more detailed pain assessment, patient satisfaction and opiate consumption.

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		Thoracic epidural n=35				Rectus sheath catheters n=26			
Patient age (mean, years)		71.3				69.2			
Laparotomy incision type		Midline		Transverse		Midline		Transverse	
% of patients		45.7		54.3		53.8		46.2	
Length of hospital stay (mean, days)		7.3				7.9			
Length of high care stay (mean, hours)		66.4				54.6			
Pain scores*		0	1	2	3	0	1	2	3
% of patients with this pain score	Recovery	67.6	20.6	11.8	-	63.6	18.2	18.2	-
	6 hrs post op	87.5	6.3	3.1	3.1	87.5	12.5	-	-
	24 hrs post op	61.7	35.3	2.9	-	75.0	16.7	4.2	4.2
	48 hours post op	75.7	24.2	-	-	83.3	16.7	-	-
Vasopressor required (% of patients)		77.1				26.9			
Vasopressor duration (mean, hours)		38.6				32.4			
Nausea/vomiting documented (% of patients)		5.7				26.9			
Ileus documented (% of patients)		5.7				7.7			
First mobilisation (mean, post op days)		3.6				2.9			
Respiratory complications documented (% of patients)		17.1				15.4			

\*Pain scores routinely recorded by nursing staff. 0=no pain, 1=mild pain, 2=moderate pain, 3=severe pain.

# **A Viewpoint into Theatre Efficiency within Vascular Surgery across London and South East England**

*Katherine Grailey, Royal London Hospital*

The desire to meet theatre efficiency targets unites all surgical specialties and institutions - drivers for improvement include patient satisfaction, optimal use of financial resources and effective staffing (1). Vascular surgery has been the subject of multiple initiatives to optimise its efficiency (2), which can be compromised not only by organisational inefficiencies, but the high prevalence of patient frailty, comorbidities and the capacity for unexpected intraoperative events. Given the Anaesthetists overarching role in the patients' perioperative journey, we felt they were perfectly positioned to provide a viewpoint into theatre efficiency.

We conducted a prospective review into theatre efficiency across 40 institutions in London and South East England, recruited using the Pan London Perioperative Audit and Research network. Following clinical governance approval, surveys were distributed to the most senior Anaesthetist covering each elective list over a 5 day period in January 2016. Data regarding theatre list demographics, perceived reasons for inefficiency and utilisation of operating time were collected; and audited against Royal College of Anaesthetists (RCoA) standards.(3)

We received surveys from 1453 operating lists, with a response rate of 77.4%. 52 lists were vascular, 23 of these located within a tertiary centre. 51 [98.0%] of the lists were managed by Consultant Anaesthetists, with 48 [92.3%] by Consultant Surgeons. 35 [67.3%] were scheduled as all day lists. 24 [46.1%] reported an overrun of <15 minutes, with 17 [32.6%] reporting they began < 10 minutes of their scheduled start time, and 37 [71.1%] utilising at least 90% of theatre time; in accordance with RCoA standards. 108 factors were cited across these 52 lists as contributing to theatre inefficiency, with processing, patient flow and scheduling factors being most prevalent [Figure 1]. When asked about the potential negative impact of theatre inefficiency 11 [21.1%] stated it led to the creation of conflict within the team, and 8 [15.3%] as preventing staff from taking adequate breaks.

How to improve theatre efficiency? Vascular services have already been streamlined, with the incorporation of multidisciplinary working and focus on pre-optimisation, yet over half of all lists were deemed by Anaesthetists as inefficient. Whilst this survey only considers the opinion of one clinical staff group, the concordance in identifying factors felt to cause inefficiency suggests that this may provide an excellent point from which to further develop quality improvement projects and improve patient flow. It demonstrates that despite improvements, vascular surgery still falls prey to issues common to all specialties – such as timely sending for patients and appropriate list scheduling.

Our survey also highlighted the opinion that theatre inefficiency may negatively impact staff wellbeing, thereby providing an opportunity to improve staff morale, particularly relevant given current concerns regarding the increasing demand placed on our workforce.

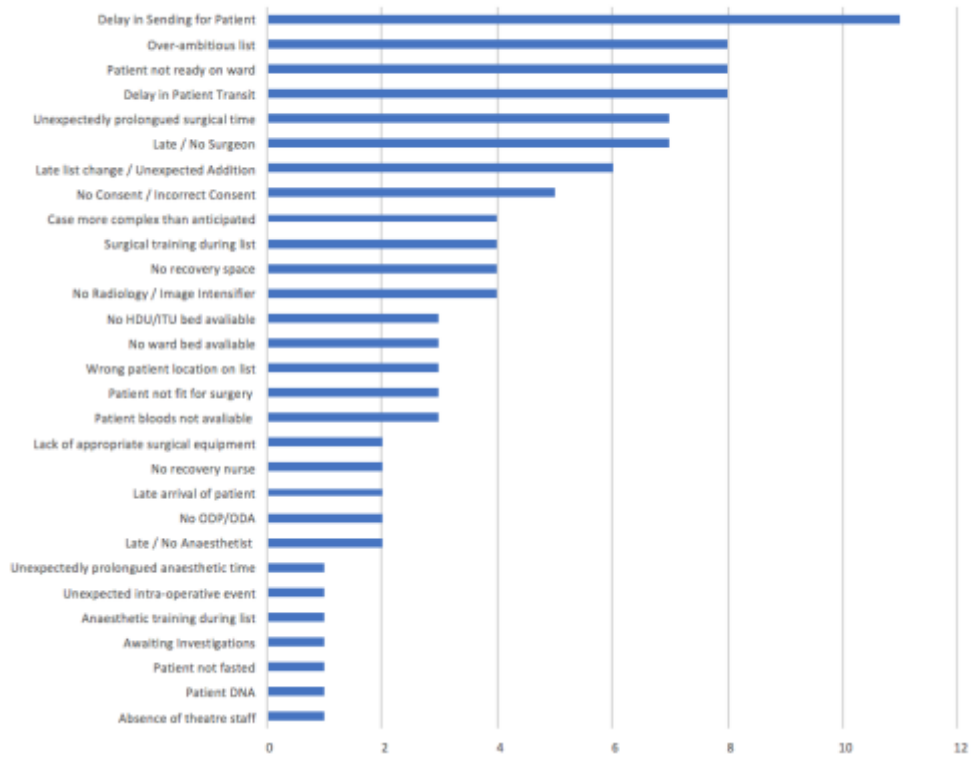
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## Acknowledgements

PLAN Members and Committee

### Factors cited by Anaesthetists as contributing to Theatre Inefficiency within Vascular Operating Lists



## **A survey of fluid management in elective, open AAA repair surgery**

*John Whitaker, Sheffield Teaching Hospitals*

Our hospital has been using elements of enhanced recovery after surgery (ERAS) programmes, such as carbohydrate loading, in the management of elective open abdominal aortic aneurysm (AAA) repair. Locally, there are also differing opinions regarding the usefulness of cardiac output monitoring in the presence of an aortic cross-clamp. We therefore conducted a survey to investigate the scope of practice in these areas and the overall management of fluid status for this operation.

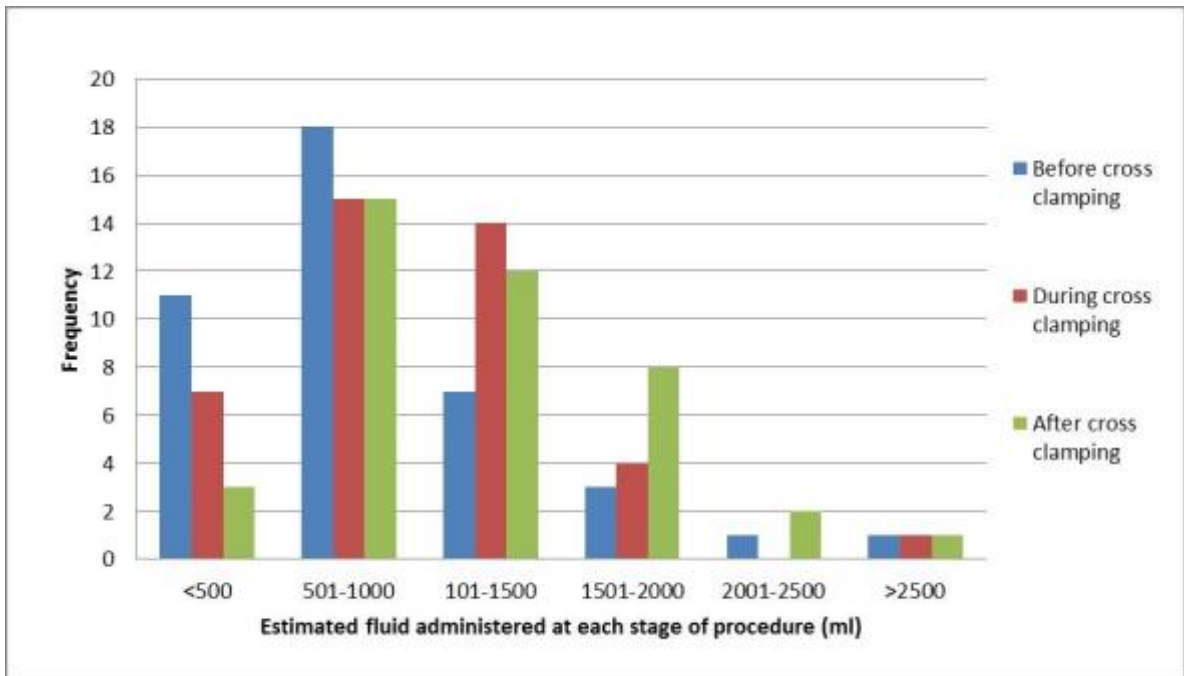
In August 2016, an online survey was sent to vascular anaesthetists from 42 centres performing AAA repair as identified using the National Vascular Registry. The survey used the Survey Monkey website and responses analysed using Microsoft Excel. 56 responses were received overall. The majority (90%) of respondents state that they anaesthetise for AAA repair two or fewer times a month.

Most centres cease fluids two hours preoperatively, although 11% (6 centres) allow patients to drink within 30 minutes of surgery. Preoperative fluids are rarely used, although 22% state that they consider use in diabetes, renal impairment or delayed surgery. The reasons for avoiding intravenous fluids were risk of fluid overload, reduced patient mobility and day of surgery admission. One fifth of anaesthetists use preoperative carbohydrate drinks with better hydration, reduced stress response and enhanced recovery as the stated benefits. The risk of hyperglycaemia and aspiration were the main reasons for avoiding their use. 10 respondents (18%) report having guidelines for carbohydrate loading in their departments.

66% of respondents use intraoperative cardiac output monitoring with 13% continuing postoperatively. Multiple devices are used, mostly LiDCO Rapid or Oesophageal Doppler. Pulmonary Arterial Catheters are used by two anaesthetists in suprarenal aneurysms and one reported occasional use of Transoesophageal Echocardiography. Figure 1 shows anaesthetists' estimates of intraoperative fluid administration vary widely, although in general more fluid is given after reperfusion than before or during cross clamping. Mean estimated fluid administration was 3037ml. All respondents routinely used cell salvage with a mean of 580ml re-transfused and only 29% routinely give red cells intraoperatively. 45% of anaesthetists used point of care coagulation testing.

Although some anaesthetists are practicing elements of ERAS pathways for AAA repair the practice is not widespread. This may reflect the relative scarcity of evidence in when compared to other intraabdominal surgeries or the effects of aortic cross clamping complicating the use of goal directed fluid therapy. We are not aware of any guidance relating to the use of cardiac output monitoring in AAA repair and as a result, the method for doing so varies greatly. The reported intravenous fluid use tallies with our own experience that most fluid is given towards the end of surgery in order to manage the instability that can occur with reperfusion. Routine red cell transfusion is uncommon, likely as a result of the universal use of cell salvage.

Overall, we have obtained an interesting snapshot of clinical practice, which varies greatly in some areas such as use of enhanced recovery protocols and of cardiac output monitoring. This is likely a result of no compelling evidence for their usefulness in open AAA repair, and suggests that clinicians are using their own judgement to guide practice in these areas.



# Current Anaesthetic Practices for Elective Endovascular Abdominal Aneurysm Repair in a Tertiary Hospital in Singapore

*Lim Ming Jian, Singapore General Hospital*

Endovascular abdominal aneurysm repair (EVAR) is a procedure that has been gaining popularity worldwide due to its tolerability, lower mortality and morbidity, and shorter hospital stay.(1) However, there is no consensus on the ideal anaesthetic technique for this procedure. A recent systematic review in 2012 has shown that the current evidence comparing local anaesthesia (LA) with sedation or regional anaesthesia (RA) and general anaesthesia (GA) for EVAR was not robust as the data came from non-randomised studies.(2)

We conducted a survey in June 2017 in order to capture a snapshot of the current anaesthetic practices amongst the consultants in Singapore General Hospital (SGH) and examine the factors that will influence their choice of anaesthetic technique. SGH is the biggest tertiary teaching hospital in Singapore with 1700 beds. Currently in SGH, there is no vascular anaesthesia subspecialty hence vascular lists, including EVAR, are covered by general anaesthetists.

50 consultants from our department participated in our survey. This represented a response rate of 70.4%. Table 1 shows the results of the survey.

In our survey we found that GA with ETT insertion was the most frequently used anaesthetic technique.

Only 12% would not insert an intra-arterial (IA) line routinely. Out of those who would not insert an IA line, a high likelihood of aneurysm rupture was the most important consideration for IA line insertion.

70% of participants would not insert a central venous catheter (CVC) routinely. Of those who did not insert a CVC routinely, presence of severe cardiovascular disease and high likelihood of aneurysm rupture were the most important considerations for CVC insertion.

32% would consider RA. Of those who would consider RA, a low likelihood of aneurysm rupture was the most important determinant for choosing RA technique.

48% would consider LA and the most influential reason for their choice is the cooperativity of the patient.

50% would not routinely intubate patients under GA. The determining factor for intubation is the high likelihood of aneurysm rupture.

The results of the survey led us to conclude that anaesthetic practice amongst the consultants for elective EVAR is variable and non-evidence based. More research is required to determine the best anaesthetic techniques for elective EVAR for different subgroups of patients.

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## **Outcomes of Patients Undergoing Open Abdominal Vascular Operations Using Cell Salvage At The Queen Elizabeth University Hospital, Glasgow**

### *Outcomes of Patients Undergoing Open Abdominal Vascular Operations Using Cell Salvage At The Queen Elizabeth University Hospital, Glasgow*

The Queen Elizabeth University Hospital (QEUH) opened in May 2015, thus centralizing vascular services in Greater Glasgow and Clyde (GGC). Since then data regarding the use of cell saver technology in open vascular cases has been collected. This dataset was used to compare results for QEUH patients to historical GGC data (pre-centralization and prior to cell saver use) and national standards. The primary outcome examined was the total number of red blood cell (RBCs) units transfused intra-operatively and up to day 10 post procedure.

Patients were identified from audit sheets completed whenever the cell saver was used. A retrospective review of online patient notes was then performed looking at RBC use in the perioperative period.

20 open vascular cases (17 abdominal aortic aneurysm [AAA] repairs, 3 aorto-bifemoral grafts) were performed between 19/11/15 and 14/12/16. 17 patients were male with a median ASA of 3. Median age (inter-quartile range, [IQR]) was 64years (64-71). Median Hb (IQR) prior to surgery was 145g/L (135-160). Median estimated blood loss (IQR) was 1290ml (590-2105). Median volume of autologous blood transfusion was 485ml (350-655). 4 (20%) patients received RBCs from the blood bank (1 intra-operatively, 3 post-operatively). Median (IQR) length of stay was 8 days (6.8-8.5). Comparison of blood product use in a group of elective open cases performed prior to centralization and introduction of cell saver is shown in Table 1.

14 patients (70%) experienced complications. 9 (45%) suffered an acute kidney injury (AKI), defined as an increase of greater than 50% from baseline. 5 patients suffered AKI in isolation. 4 had an AKI associated with other complications. Median length of stay (IQR) was 8 (6.8-8.5) days with a range of 5-146 days.

From our data, the introduction of the cell saver has reduced the blood transfusion requirements of patients undergoing open abdominal vascular surgery compared to historical controls. Our findings are similar to a study by Pasternak et al 2014 which found that cell saver significantly reduced intra-operative allogenic blood transfusion (1). When compared to the Vascular Society National Vascular Registry Report 2016 (2), the overall complication rates in our group are comparable to the national average. However, our incidence of AKI was significantly higher. The median length of stay for the study group was 8 days, which compares favourably with GGC median length of stay of 11 days (7-14) for elective open AAA repairs in 2016 (2).

Weaknesses of the study include its retrospective nature and potentially missed cell salvage patients. We plan a prospective study looking at outcomes of patients who have undergone elective open abdominal vascular surgery within GGC with or without the use of intra-operative cell salvage technology. We also plan to investigate further our apparent high rates of AKI.

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<b>Table 1: Post-op transfusion requirements for elective open vascular procedures performed at Southern General/QEUH</b>		
	Without cell saver 2003-2004	Cell saver used 2015-2016
<i>n</i>	39	20
AAA	18	17
ABG	21	3
<i>Median Age (IQR)</i>	66 (48-81)	68 (64-71)
<i>Average Pre-op Hb</i>	130.8	143.9
<i>% of patients receiving blood transfusion</i>	24 (61%)	5 (25%)
<i>Average number of units transfused</i>	3	2.2
<i>Total units transfused</i>	Unknown	11

## **Should we be measuring Activated Clot Times in peripheral vascular surgical patients after heparinisation – an ongoing debate**

*Natalie Smith, Derriford*

In 1979 Charles et al concluded that the Activated Clot Time (ACT) should be ‘maintained at greater than twice the control value when heparinisation is required for peripheral vascular surgery’(1), with an ‘initial dose of 130units/kg being adequate in 95% of patients.’(1) There has been very little work in this area since. Currently there are no local or national guidance on giving or monitoring heparin in patients having peripheral vascular surgery. Our aim was to establish whether we currently achieve ACT levels as suggested by Charles et al.

The primary reason for giving heparin is to prevent thrombosis. It needs to reach sufficient plasma levels to achieve this. Heparin is a large acidic molecule and works by binding to antithrombin III, inactivating several clotting factors including thrombin. Heparin is eliminated via two mechanisms. Firstly by the reticuloendothelial system and secondly by renal excretion. The contribution of each method will depend on the dose delivered, at higher doses renal excretion plays a bigger role. Those patients with decreased renal function will have reduced elimination and therefore prolonged effects. The ACT has been established as a suitable bedside test for the measurement of heparinisation as changes in the ‘ACT are directly and linearly proportional to the concentration of heparin’ (2).

Locally elective vascular patients receive between 3000 and 5000IU of heparin before clamping of the vessel. The dose is decided by the surgeon, it is not calculated on weight or renal function, but rather individual preference. No further doses are then given and the ACT is not routinely measured.

I evaluated current practice by measuring the ACT using a ‘Hemochron Signature Elite’ coagulation monitoring system. A baseline blood sample was taken on insertion of the arterial line. Another sample was taken from the arterial line 3 minutes after the heparin was given. Both the surgeons and anaesthetists were blinded to the ACT results to prevent any deviation from routine practice.

Twenty elective patients were included. Our results show we are not achieving the recommendations of Charles et al (1) as the post heparin ACT only doubled from their baseline in three patients. The dose varied between 30-130IU/kg in our study. One patient had a graft occlusion on day two post-operatively and required further vascular intervention. None of the patients suffered immediate post-operative complications with bleeding.

5% of our cohort developed graft occlusion and sub-therapeutic heparinisation may have contributed to this. As such varied doses of heparin are being given and with little regard given to its elimination it is no surprise that the ACTs were varied and mostly sub-therapeutic. If we are to administer heparin, which does not come without risk, its effectiveness should be accurately measured to ensure all of our patients receive a consistent standard of care.

Before we introduce guidance recommending doubling patients baselines ACTs we first need to establish optimal levels of heparinisation and confirm the conclusions of Charles et al(1).

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## **Major lower limb amputations; One year follow up in a regional vascular unit**

*Caroline Curry, Royal Victoria Hospital Belfast*

Major lower limb amputations (MLLAs) represent a growing group of patients. In 2010 the Vascular Society produced a quality improvement framework aiming to reduce mortality to less than 5 % by 2015 and in 2014 MLLAs were the focus of the NCEPOD report(1). Following centralisation of vascular surgery in Belfast we have audited our current practice against the NCEPOD recommendations.

This was a prospective audit from 1st August 2015 to 31st July 2016. Cases were identified using our theatre management system and during our data collection period 119 major lower limb amputations were performed on 111 patients. 102 of these patients were followed up for 1 year using the Northern Ireland Electronic Care Record and causes of death were obtained from the Public Records Office of Northern Ireland (PRONI).

30 day mortality was 8.8% with bronchopneumonia listed as the cause of death in 50% of these cases. 11.7% of our patients were still inpatients on the vascular ward after 30 days and 2.9% of patients went on to have a further amputation within the first 30 days post-operatively . 90 day mortality was 17.6%. Over one third of these deaths were due to bronchopneumonia and a further third due to ischaemic heart disease or congestive cardiac failure. At 1 year our mortality rate was 28.4% with half of these deaths attributed to cardiac causes and over a third to bronchopneumonia.

As part of our units ongoing work to implement the NCEPOD recommendations and to improve the care pathway for patients undergoing major lower limb amputation we have been able to follow up our cohort of patients for twelve months after their amputation. This has given us a better understanding of the longer term prognosis for these high risk patients and their ongoing medical problems. Our 30 day mortality of 8.8% is below the average found by the NCEPOD report in 2014 but higher than our target of 5%. For patients who survive the first 90 days after surgery it is reassuring to see that 1 year after their amputation 65% of our patients are living in their own home or nursing home. Unsurprisingly bronchopneumonia and cardiac disease were the leading causes of death at all three time periods.

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## **Right or left arm non-invasive blood pressure measurement in vascular inpatients: does it matter?**

*Satinder Dalay, Birmingham Heartlands Hospital*

Evidence suggests that non-invasive blood pressure (NIBP) readings between the right and left arms of vascular patients often show discrepancies (1-2). The National Institute for Health and Care Excellence (NICE) recommends measurement of blood pressure in both arms, with subsequent monitoring and management using the higher reading arm (2-3). The degree of discrepancy in systolic blood pressure (SBP) can be used to indicate severity of peripheral vascular disease, risk of a cardiovascular event, early detection of subclavian stenosis (1), presence of cerebrovascular disease, and risk of death (4).

We hypothesised that the recorded ward-based NIBP of our vascular patients did not consider a possible interarm difference. We conducted a prospective audit using NICE guidance (3) in April 2017 of NIBP measurements in vascular inpatients at the Dudley Group of Hospitals. We recorded the left and right NIBP twice using an appropriately sized cuff and dynamap NIBP machine. We also recorded whether NIBP readings on bedside observation charts and admission documents stated the arm the reading was taken from. The average interarm SBP difference was calculated for each patient.

We collected two sets of NIBP readings for 40 vascular inpatients with an average age of 73 years and a male: female ratio of 29: 11. Twenty-eight patients had a normal average interarm SBP difference of < 10mmHg (4). Seven patients had an average interarm SBP difference of between 10-14mmHg; four patients between 15-19mmHg and one patient had a difference > 20mmHg. None of the patients had the arm their NIBP reading was taken from documented on their bedside observation chart. Admission notes were available for 39 patients, none of whom had the arm their first NIBP reading was taken from recorded.

Despite the small sample size analysed in our snapshot audit, just over one-quarter of patients had an interarm SBP difference that would be classified as significant. This is usually caused by atherosclerosis of the ipsilateral subclavian artery (4). The higher reading should always be used clinically, if there is interarm variability. Failure to do so may lead to treatment of erroneous hypotension, such as unwarranted fluids or vasopressors. For the same reason, it is important to establish any interarm variability preoperatively, so that arterial lines and NIBP can be sited on the correct limb (2). A SBP difference of 15mmHg or more is associated with increased incidence of cardiovascular mortality and all-cause mortality (4). Therefore, knowledge of interarm SBP difference may also aid risk stratification. We have now introduced a policy in preoperative assessment and on the vascular ward, that initial NIBP readings should be taken from both arms for comparison. Should significant interarm variability be found, it is cascaded to clinical teams and treatment directed consistently to the higher reading arm.

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We declare no conflicts of interest. No funding received.

## **Review of Maximum Surgical Blood Ordering Schedule for Elective Vascular Surgical Patients: Is our ordering excessive?**

*Alexandra Murphy, Royal Victoria Hospital*

The Maximum Surgical Blood Ordering Schedule (MSBOS) for vascular patients in our tertiary centre was constructed several years ago in consultation with the multidisciplinary team. It was based on the likelihood of transfusion requirements intraoperatively for each of the common vascular procedures performed. It lists the number of units of Packed Red Cells (PRC) that should be routinely requested for cross-match pre-operatively. The junior doctors on the ward are frequently responsible for completing this task and are provided with the MSBOS with the aim of minimising requests for cross-matched PRC in excess of the agreed guide. This saves wastage of resources in the blood bank laboratory while maintaining a safe standard for those procedures where it is agreed that PRC should be cross-matched pre-operatively.

Recently, it has been observed that a number of patients have had requests for cross-matched PRC in excess of the suggested number of units on the MSBOS. In order to quantify how frequently this was occurring, an audit of current practice was designed and performed.

A retrospective review of blood ordering over a two week period included all patients booked onto an elective list in either vascular theatre. The intended surgical procedure was recorded, along with the number of cross-matched units of PRC requested and the suggested number as per the MSBOS. The staff at theatre reception routinely ask each theatre to confirm their request for blood products on the morning of surgery. This request may either be confirmed by the theatre nursing staff or anaesthetic staff. This data was also collected as part of the audit.

A total of 42 patients were identified, each booked for one of 14 vascular procedures. Upon analysis of the results, 39 patients (93%) had cross-matched PRC ordered in agreement with the guidance laid out in the MSBOS. Two patients had less blood ordered, while only one had a request in excess of the recommendation.

However, when the blood ordering was compared to the morning request from theatre, only 81% patients had the appropriate number of units of PRC cross-matched. It was also noted that there were inconsistencies in the requests from theatre for identical procedures.

When compared to the MSBOS of other trusts in the UK (1, 2, 3), our local guidance advocates cross-match of more PRC for a considerable number of vascular procedures.

This audit has highlighted that the junior doctors on the vascular ward appear to largely adhere to the guidance provided in the MSBOS without significant wastage of resources at the blood bank laboratory.

However, the data collected suggests that perhaps the MSBOS guidance needs to be revised to better reflect current evidence and best practice, as well as the consensus of the current multidisciplinary team.

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# The changing face of perioperative care for endovascular aortic aneurysm surgery

Shamir Karmali, Northwick Park Hospital

Endovascular aortic aneurysm repair (EVAR) techniques have significantly changed the perioperative management options available to patients and clinicians. Endovascular approaches enable the use of locoregional anaesthesia techniques to suitable patients. In line with joint guidance provided by the Medicines and Healthcare Products Regulatory Agency (MHRA) and Vascular Society of Great Britain and Ireland (VASGBI), Northwick Park hospital built a dedicated vascular or “hybrid” suite in the main theatre complex in October 2014 (1) and recruited a specific lead for interventional vascular surgery in 2016. The aim of this study was to assess how our patients, anaesthesia techniques, provision of critical care resources and length of stay has been affected with these organizational changes.

A retrospective analysis of data collected through the National Vascular Registry (NVR) database was performed for a six month period for three consecutive years: January to June 2014 (prior to hybrid suite), January to June 2015 and January to June 2016. Data collected included patient demographics, co-morbidities, mode of anaesthesia and surgery, discharge location and length of stay.

Full data was available for 88 patients. Data are summarized in Table 1. Key findings included an overall reduction in AAA surgery volume from 2014 to 2016, increased surgery on older patients ( $74.6 \pm 9.5$  in 2014 vs  $79.5 \pm 6.6$  in 2016,  $p = 0.036$ ), increased prevalence of CKD, increased use of local anaesthesia techniques and decreased use of critical care resources with increased discharges directly to the ward. There was no significant difference in proportion between endovascular and open approaches, or aneurysmal size across the three year period (data not shown).

We are increasingly performing endovascular surgery on multimorbid octogenarians, likely reflecting the uptake of evidence that these patients have satisfactory outcomes and should be considered for surgical intervention (2). Increased use of local anaesthesia techniques in these multimorbid and frailer patients and reduced utility of critical care resources in our data is consistent with published literature that locoregional anaesthesia techniques may be associated with reduced uptake of high dependency and critical care resources and length of stay (3). This may reflect greater familiarity with endovascular techniques, avoidance of general anaesthesia and improvements in perioperative care.

Limitations of these data however must be borne in mind including lack of postoperative morbidity data on the NVR database and the small sample sizes in this study. Nevertheless, a trend has emerged since the introduction of a modern hybrid suite and specialist interventional vascular personnel which has led to changes in the perioperative management of generally older complex patients that has affected the anaesthetic modality delivered and use of critical care resources.

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	2014	2015	2016
Total number of cases	37	33	18
Age (mean $\pm$ SD)	74.6 $\pm$ 9.5	75.9 $\pm$ 8.8	79.5 $\pm$ 6.6
ASA (median)	3	3	3
Diabetes Mellitus (%)	9 (24)	5 (15)	2 (11)
Hypertension (%)	22 (59)	28 (85)	13 (72)
Chronic Lung Disease (%)	7 (19)	14 (42)	5(28)
Ischaemic Heart disease (%)	12 (32)	13 (39)	7 (39)
Heart Failure (%)	1 (3)	6 (18)	0 (0)
Chronic Kidney Disease (%)	3 (8)	5 (15)	4 (22)
Stroke (%)	2 (5)	1 (3)	1 (5)
Smoking (%)	(81)	29 (88)	17 (94)
GA (%)	18 (49)	17 (51)	5 (28)
RA (%)	18 (46)	14 (42)	10 (55)
LA (%)	1 (3)	12 (6)	3 (17)
ICU (%)	3 (8)	5 (15)	0 (0)
HDU (%)	26 (78)	17 (53)	12 (67)
Ward (%)	5 (13)	11 (33)	6 (33)
Length of Stay (Median)	5	6	4.5

## **Does peripheral nerve block improve outcomes in below knee amputations?**

*James Sylvester, Doncaster Royal Infirmary*

Below knee amputation is a common procedure with over 5,000 performed annual in the UK. The patient population often have multiple co-morbidities and suffer from significant post-operative pain. These factors make choosing the correct anaesthetic plan vital.

A retrospective audit of all patients presenting for below knee amputation between 01/01/2015 and 01/01/17. In total 50 patients underwent below knee amputations, of these 35 sets of notes were available. Case notes and electronic prescriptions were analysed. Data was collected on; patient demographics, type of anaesthetic, amount of post op analgesia required, time to mobilisation and time to discharge.

Of the 35 patients analysed 15 were female and 20 were male. 10 operations were performed as an emergency and 25 were elective amputations. 15 patients had a peripheral nerve block, 4 of these without any supplemental anaesthesia. 11 patients had a combined spinal and continuous epidural infusion; the remaining 9 patients either had a single shot spinal or general anaesthetic. Time to mobilisation was lower in the regional anaesthesia group median 2 days (range 1-4), patients having a CSE had the longest time of immobilisation median 4 days (range 3-8). Post-operative analgesia requirements were similar for patients in the CSE and peripheral block group median 3 doses of opiates per day for both groups. Time to discharge was shortest for the peripheral never block group by an average of 2 days.

Peripheral nerve block with appears to provide similar post-operative analgesia compared to a continuous epidural infusion. Time to mobilisation is improved and as is time to discharge.



## **Postoperative pain management in patients presenting for lower limb amputations. Audit of current practice in Tertiary referral centre**

*Anna Malik, St George's Hospital*

St George's University Hospital is a tertiary referral centre for complex vascular surgery. There are around 100 lower limb amputations performed each year. The pain following amputation is considered one of the worst in human experience. Poor perioperative pain control is implicated in development of chronic pain. National Confidential Enquiry into Patient Outcomes and Death recommended formal pain management protocol, better pain control in preoperative period and access to an acute pain team. [1] Our aim was to investigate the quality of perioperative pain control and analgesic regimes used by our anaesthetists with a view to propose a formal pain management pathway based on the best evidence.

Ninety-four patients underwent lower limb amputation in 2015. A retrospective audit of 50 randomly selected patient's postoperative records was undertaken. The data regarding highest pain scores for five postoperative days was collected and postoperative analgesia was reviewed. Pain scores were analysed based on a numerical rating scale of 0–4 (0 = no pain, 1 = mild, 2 = moderate on movement, 3 = severe on movement, 4 = continuous).

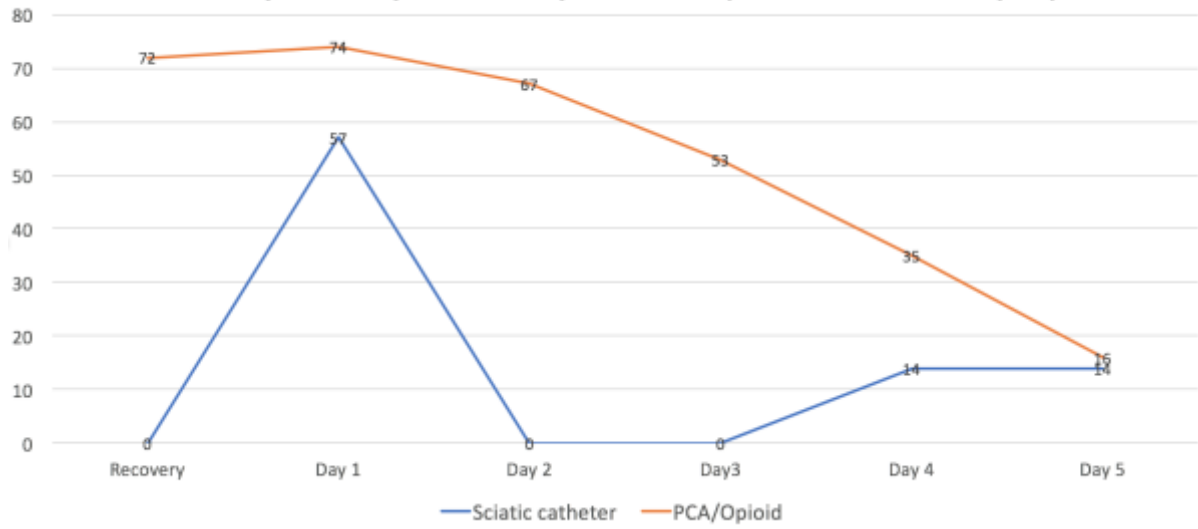
The records showed that out of 50 procedures performed there were 24 below knee amputations, 23 above knee amputations and 3 through knee amputations. Forty-three patients (86%) received patient controlled analgesia (PCA) or strong oral opioids in postoperative period. In this group, there was no significant difference in number of patients reporting moderate to severe pain throughout the postoperative period regardless of level of amputation. Alarming, seven patients (29%) in below knee amputation group and six patients (26%) in above knee amputation group were still reporting moderate to severe pain on fourth postoperative day. The number reduced to 3 in below knee amputation group and to 2 in above knee amputation group on fifth postoperative day. Sciatic peripheral nerve block catheter was inserted in 7 patients (14%), five of them underwent above knee amputation and 2 below knee amputation. Patients in this group consistently reported lower pain scores throughout the postoperative period and communicated lack of pain more than seventy percent of the time. The local anaesthetic infusions were discontinued on the third postoperative day resulting in recurrence of pain in one patient from below knee amputation group. After second postoperative day, no other patients in sciatic peripheral nerve block catheter group reported moderate or severe pain.

Regional anaesthesia provided superior pain relief in our patients. A literature review confirmed that it should be a gold standard for pain management in these patients. [2,] We have now developing a formal pain management pathway for lower limb amputations with sciatic peripheral nerve block catheter being an integral part of it. Our aim is to ensure that every patient has sciatic peripheral nerve block catheter inserted before or after the procedure and is reviewed by our pain team in perioperative period. The infusion should continue beyond third postoperative day and none of the patients should suffer moderate to severe pain.

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1. National Confidential Enquiry into Patient Outcomes and Death. Lower Limb Amputation: Working Together. November 2014
2. Neil M, Grant C, Shepherd V, Colquhoun L. Development of a best practice guideline for the prevention and management of acute phantom limb pain. *Pain News* 2014;12(2):113-118

Proportion of patients with pain score >1 (Moderate and severe pain)



## **Gaining Mastery in Vascular Anaesthesia-A Survey of Advanced Vascular Training**

*Daragh Lehane, Southmead Hospital*

The Royal College of Anaesthetists (RCoA) and Vascular Anaesthesia Society of Great Britain and Ireland (VASGBI) have both published expected learning outcomes for an advanced module in vascular anaesthesia. The RCoA outlined core clinical outcomes that must be achieved, including gaining “mastery in the delivery of safe and effective perioperative anaesthetic care to patients undergoing complex vascular procedures [including intra-thoracic]”[1]. In 2013, VASGBI developed a consensus document outlining the standard of training expected from an advanced module in vascular anaesthesia[2]. The document included a recommended number of logbook cases that should be achieved (see Table 1).

The aim of this study was to compare outcomes from local advanced training in vascular anaesthesia, following centralisation of vascular services in 2014, to the learning outcomes set out in these documents. We planned to survey trainees who had completed the advanced module in North Bristol NHS Trust between 2014 and 2016.

We designed a short questionnaire using SurveyMonkey. This asked respondents whether they had achieved the separate core clinical outcomes for advanced vascular anaesthesia set out by the RCoA[1] and to specify vascular case numbers they had achieved during the advanced module and during training as a whole. We identified all the anaesthetists who had completed the advanced module in the Trust from records kept by College Tutors and contacted them via email about the survey.

Seven anaesthetists completed the module during this time and we received 6 survey responses. 100% felt that they had gained mastery in the delivery of safe and effective perioperative anaesthetic care to patients undergoing complex vascular procedures. With respect to proficiency in the management of the complex vascular patient, all participants felt at least competent, with 67% gaining mastery in management of the complex vascular patient. We also compared respondents’ case numbers with VASGBI’s suggested case numbers for index cases (Table 1).

North Bristol NHS Trust is a major arterial centre delivering vascular services for 1.3 million people in the South West. It performs complex endovascular procedures including fenestrated and thoracic endovascular aneurysm repairs and is the regional centre offering renal transplant and open aneurysm repairs. Our survey demonstrates that, following an advanced module in this centre, the majority of trainees do not achieve the index case numbers suggested by VASGBI. However, they do consider themselves competent in the perioperative management of the complex vascular patient. Future work based on this study would include all regional vascular centres in the UK to determine if the results are nationally applicable. Our findings initiate further discussion regarding the appropriate and achievable number of cases necessary to train as a vascular anaesthetist.

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Table 1. Comparison of index vascular case numbers achieved by survey respondents with VASGBI suggested case numbers

Procedure	VASGBI suggested number of cases	Number of respondents achieving given case numbers during training					Percentage (%) of respondents achieving VASGBI suggested case numbers in training overall
		<5 cases	5-9 cases	10-19 cases	20-29 cases	>=30 cases	
Carotid endarterectomy	30	0	0	2	2	2	33.3
EVAR	30	0	0	4	1	1	16.7
TEVAR	5	5	1	0	0	0	83.3
FEVAR		2	4	0	0	0	
Open aneurysm	10	0	0	4	1	1	100
Thoracic aneurysm	4	5	1	0	0	0	16.7

## Vascular Prehabilitation - A Pilot Observational Study

*Dr Craig B Smith, Royal Liverpool University Hospital*

Cardiovascular disease presents a significant burden to the UK. It has recently been identified that diseases of arteries (excluding coronary artery disease) and stroke account for 8% and 11% of deaths in males and females respectively in the UK (1).

Aggressive risk factor modification is required to reduce morbidity and mortality associated with vascular disease. The relationship between vascular disease and modifiable lifestyle cardiovascular risk factors is widely recognised (2). We know sedentary lifestyle, obesity, smoking, diet, diabetes and hypertension have strong link to the development and progression of vascular disease. Opposing these risks, healthy diet and physical activity can reduce the burden and morbidity of vascular disease. We were also interested in poor dental hygiene as a potential risk factor perioperative infection.

With these points in mind, we set out to undertake a lifestyle questionnaire to identify social habits and lifestyle choices of patients undergoing vascular surgery at the Royal Liverpool University Hospital (RLUH). The long term aim of this project is to better understand the 'prehabilitation' needs of our patients and to develop a quality improvement programme focussed on patient education of modifiable risk factors in vascular disease.

Patients attending the RLUH for any vascular surgical procedure/operation over 30 day period were identified. We enrolled (37 patients). Participating patients undertook an initial questionnaire and a follow up phone call at 30 days.

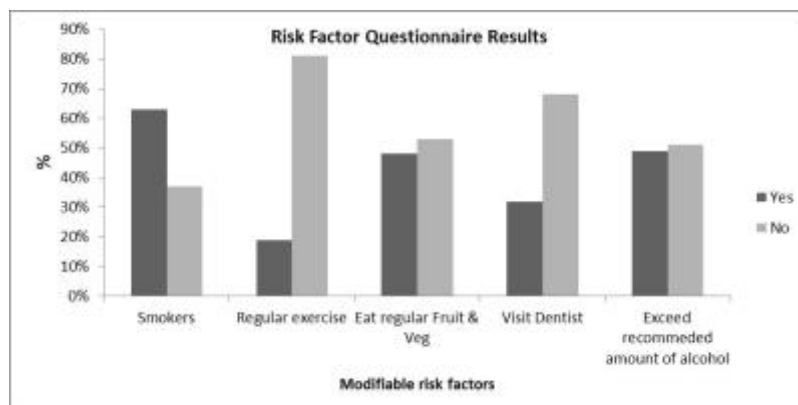
We found the majority of patients had modifiable risk factors that would be suitable to intervention. In particular, many are smokers (63%) with poor dental hygiene (68%), poor diet (48%), a high alcohol intake (49%) and sedentary lifestyles (81%).

Interestingly, the 30 day follow up revealed a proportion of patients had indeed modified their lifestyle risk factors by engaging in smoking cessation programmes as well as reducing their alcohol intake. In an era where perioperative medicine is at the forefront of anaesthesia, vascular patients would benefit from education and early interventions to allow pre-optimisation of modifiable risk factors and therefore improve patient outcomes.

This pilot observational study gives us scope to plan for a quality improvement programme for vascular patients at the RLUH. Ideally a patient education programme should be implemented at the earliest opportunity in the pre-operative phase by means of patient workshop and/or information leaflets.

### References

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- 2)Berger JS, Hochman J, Lobach I et al. J Vasc Surg. 2013 Sep;58(3):673-81. Modifiable risk factor burden and the prevalence of peripheral artery disease in different vascular territories.



## **Gaining accreditation for vascular anaesthetic services: the Anaesthetic Clinical Service Accreditation (ACSA) process**

*Alexandra Belcher, Southampton General Hospital*

The ACSA is a process designed by the Royal College of Anaesthetists (RCoA) to provide quality improvement of anaesthetic departments in the UK through peer review. The first hospitals were accredited in 2014, covering four domains of assessment. Since then, a fifth has been developed for specialist services including adult cardiothoracics, neuroanaesthesia, ophthalmology and vascular services. We present our experience at the Royal Bournemouth Hospital of seeking vascular accreditation; one of the first to do so.

Our journey started in September 2016 with registering with the RCoA. A lead for the vascular standards (I Mowatt) was then appointed and work begun on demonstrating compliance. The majority of the work consisted of outlining current practice and consolidating existing guidelines into formal paperwork. However, it was also a welcome opportunity to update guidelines, raise standards and introduce new practice.

A folder was created mapping all our evidence to the standards, demonstrating guidelines, pathways and current practice. This, along with a short presentation of our vascular services, was presented to the ACSA review committee on March 22nd 2017. A more detailed examination of each standard then followed in a question-and-answer session. The committee is now reviewing all evidence prior to determining reaching accreditation level.

The ACSA process has enabled a detailed and thorough assessment of our vascular services. It has allowed engagement across the hospital including the chief executive. Whilst in some areas it has confirmed already good practice, other areas have benefited from review. Having a standard to achieve has been useful in channeling resources. Hopefully this will be the start of specialities raising their standards to achieve safe, effective and quality care from an internal drive.

# **Divinum Sedare Dolorum: Peri-operative pain management in patients undergoing lower limb amputations Service evaluation project**

*Anagha Tambe, Addenbroke's Hospital, Cambridge*

## Background

Amputation remains a procedure with high mortality and morbidity. The reported incidence of phantom limb pain is 50-80%. Severe pre-amputation and post-operative pain remain major risk factors for development of phantom limb pain. NCEPOD report on lower limb amputations in 2014 showed that majority of patients undergoing this procedure did not have adequate pain control and recommendations were made to optimize the same in order to improve patient experience, facilitate early mobilisation and shorten the length of stay.

## Methods

The project was enrolled with the local clinical governance committee.

Retrospective study of electronic case records was done between 16th November 2014 to 3rd January 2016.

A total of 98 records were identified. In our hospital, pain scores are recorded using numerical rating scale (NRS). NRS scores were collected for 24 hours immediate pre-operative period, recovery and for up to post-operative day 5.

Scores were collapsed into 4 groups, none-0, mild pain 1-3, moderate 4-7 and severe 8-10. Records with missing data for the individual day were discarded for analysis. The reasons for missing data were repatriation to base hospital, sedation in ICU, post-operative delirium and in small number of high risk cases post-operative death.

## Results

Approximately equal number of patients had above knee (AKA) and below knee amputations (BKA). Overall reporting of the NRS scores albeit inconsistent with respect to time, was 80%.

Pre-operative pain: 40 % of patients reported moderate to severe pain day before the operation but only 8% of patients had pain team review.

Type of anaesthetic : 62% of patients had a regional technique in the form of peripheral nerve block, spinal or peri-neural catheter. The remaining 38 % had general anaesthetic only.

Recovery: 70% of patients had good pain control. 20% reported moderate pain and 10% had severe pain. Out of the 10 patients who reported severe pain, 9 patients had no regional technique done, 1 patient had failed regional.

Post-operative Day 1: 38% patients reported moderate pain and 10% reported severe pain.

Post-operative Day 2-5: Over the course of next 4 days, the pain control improved with reduction in reporting moderate pain to 20% of patients and severe pain 5%.

Phantom limb pain: 40 patients were lost to follow up for phantom limb pain. Out of those followed up 36% reported to have phantom limb pain.

An amputation care pathway has been formed and circulated to the anaesthetists, surgeons and the acute pain service.

A multi-disciplinary working group has been set up to review the implementation and progress of the pathway.

Amputation care pathway: Key recommendations:

1. All patients should be referred to the acute pain team once the decision to amputate has been made.
2. All patients should receive regular Paracetamol and PRN Oxycodone.
3. All patients are to be re-referred post-operatively to acute pain team.
4. The anaesthetists are encouraged to use regional techniques particularly in patients in severe pre-amputation pain.
5. Surgeons are encouraged to use peri-neural catheters.

We aim re-audit the changes in the near future.

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1. NCEPOD (2014) Lower limb amputation: Working together; <http://www.ncepod.org.uk/2014lla.html>
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## Pedalling towards predicting risk in Lanarkshire vascular patients

*Stuart Watson, Hairmyres Hospital, NHS Lanarkshire*

The assessment of patients undergoing elective vascular surgery can be challenging, with results of preoperative investigations helping guide decisions on appropriateness for surgical intervention. Recent guidance from the Royal College of Anaesthetists on the provision of vascular anaesthesia services recommends that cardiopulmonary exercise testing (CPET) should be used in vascular patients to help assess functional capacity and to stratify risk (1). In Lanarkshire, CPET has been available for vascular patients since 2012.

Our aim was to investigate if CPET results of patients in Lanarkshire listed for major vascular surgery correlated with predicting mortality. A list of all vascular surgery patients that had undergone CPET since 2012 was obtained from the clinical physiology department and data collected on CPET results and mortality rates.

A total of 85 patients listed for major vascular surgery were referred for CPET over a 5 year period. 24 patients underwent open abdominal aortic aneurysm (AAA) repair, with CPET results available for 23 of these (1 unable to complete test). Of these patients undergoing CPET, 30 day mortality was 8.3% (2 patients). These 2 patients had a mean anaerobic threshold (AT) of 11.05ml/kg/min, while the mean AT of the patients in this group alive at 30 days was 13.74ml/kg/min. 1 year mortality data was available for 19 of these patients, with a 1 year mortality of 21.1% (4 patients). These 4 patients had a mean AT of 11.18ml/kg/min and mean maximum oxygen consumption (VO<sub>2</sub> max) of 16.8ml/kg/min, while the mean AT of patients alive at 1 year was 12.79ml/kg/min with a mean VO<sub>2</sub> max of 16.33ml/kg/min.

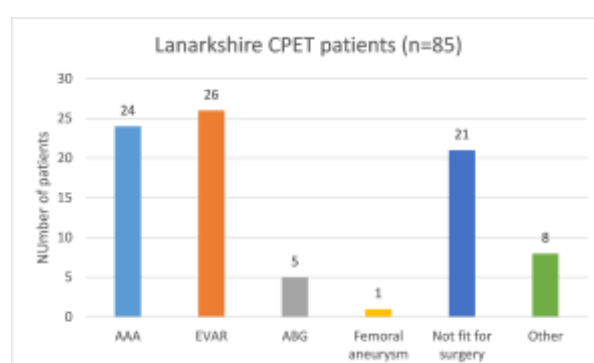
26 patients underwent endovascular aneurysm repair (EVAR) with 1 year mortality of 0%. The mean AT for 25 of these patients (1 unable to complete test) was 12.11 ml/kg/min. 5 patients underwent aortobifemoral graft (ABG), with mortality data available for 4 patients showing 1 year mortality of 0%. The mean AT was 11.1ml/kg/min. 1 patient underwent femoral aneurysm repair with an AT of 13.9ml/kg/min and was alive at 1 year. 21 patients were deemed not fit for surgery for various reasons, with 19 patients for AAA or EVAR and 2 patients for ABG. Mean AT for all these patients was 9.66ml/kg/min. On reviewing the clinical notes, it was documented in 11 cases that the decision not to operate was influenced significantly by the CPET results. The remaining reasons were patient declined (3), severe LV dysfunction on echo (1), incidental diagnosis or renal cancer (1), morbid obesity (1) and no clear documentation as to reasons (4).

Of the remaining cases 4 were referred to another health board for complex aneurysm surgery (outcome unclear), 3 continue to undergo monitoring, and 1 ruptured prior to elective repair and died day 5 post-operatively.

The number of vascular patients undergoing CPET in Lanarkshire remains small. However the data from open AAA patients suggests a correlation between AT results and mortality, with the patients in the survivor group having a notably higher AT than the mortality group at both 30 days and 1 year. This would be in accordance with current guidance that CPET is a useful tool in helping predict risk in vascular patients.

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# **Contrast induced acute kidney injury (CI-AKI) after endovascular aneurysm repair (EVAR): A tertiary referral centre's experience**

*Manik Chandra, Leeds General Hospital*

Up to 20% of vascular patients have chronic kidney disease (CKD)[1]. Those undergoing EVAR are at risk of developing contrast induced acute kidney injury (CI-AKI) for several reasons, including[2,3]:

- chronic kidney disease (eGFR <60mls/min/1.73m<sup>2</sup>)
- >75 years old
- Cardiac failure
- Large contrast volume
- Intra-arterial contrast

The international Kidney Disease: Improving Global Outcomes (KDIGO) definition of AKI includes serum creatinine rise  $\geq 26\mu\text{mol/L}$  within 48 hours[4].

AKI prevention strategies suggest pre-hydration depending on baseline eGFR and AKI risk assessment. However, this is often not adequately done due to lack of preoperative bed availability, inaccurate risk assessment and inappropriate administration of fluid.

A scoping exercise was performed to investigate our current practice and AKI incidence after endovascular procedures at our Trust.

A retrospective analysis of patients who underwent emergency and elective EVAR and TEVAR in 2015 and 2016 at Leeds Teaching Hospitals NHS Trust was performed using electronic records. Pre and postoperative Urea and Electrolytes were noted along with volume of contrast administered for each patient. Patients were deemed to have developed AKI if serum creatinine increased by  $\geq 26\mu\text{mol/L}$  within 48 hours.

Data was available for 185 patients (median age 77 years (IQR: 69-82 years). 10 (5.4%) patients demonstrated creatinine rise  $\geq 26\mu\text{mol/L}$  (range: 28-393 $\mu\text{mol/L}$ ) within 48 hours. The median volume of contrast administered was 150ml (IQR: 110-200ml). There did not appear to be a correlation between volume of contrast administered and change in creatinine (figure 1). However, the patients developing AKI appeared to receive greater volumes of contrast (median volume of 173ml (IQR: 120-250ml)).

Previous studies have indicated a CI-AKI rate of 16-19% [2,5]. The CI-AKI rate for our patient population was lower.

In our institution renal function is assessed throughout the patient pathway including during the team brief on the day of surgery which has been adapted for radiology procedures. Renal function and measures to limit CI-AKI, including limiting contrast volume and using alternatives such as carbon dioxide, are discussed. In recent years there has also been a change in the type of contrast media used- iso-osmolar contrast media is associated with lower incidence of CI-AKI.

Further work is needed to establish if a correlation exists between the volume of contrast administered per kilogram and CI-AKI. We also aim to assess the effectiveness of current pre-hydration strategies for preventing CI-AKI.

Overall, our recent experience suggests that lower rates of CI-AKI are achievable through the recognition of at risk patients by the multidisciplinary team throughout the patients' endovascular repair journey.

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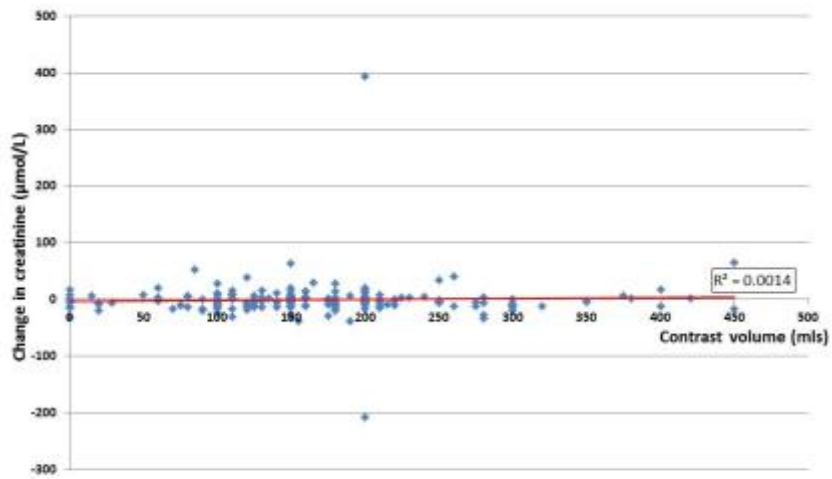


Figure 1: Chart showing there appears to be a lack of correlation between volume of contrast administered and change in creatinine.

## Get It Right the First Time: Cardio-pulmonary Exercise Testing (CPET)

*David Wotherspoon, Bedford Hospital*

We present 6 cases of CPET wherein the second test resulted in significant improvements in the anaerobic threshold (AT), peak oxygen consumption (VO<sub>2</sub> peak) and ventilator equivalents of carbon-dioxide (VeqCO<sub>2</sub>).

Based on our findings that inadequate preparation and poor test technique can contribute to 'failed' CPET in individuals who went on to have a results that were adequate to proceed to surgery, we updated our pre-test patient information leaflet with the aim of reducing test failure for non-fitness reasons. This has the value of reducing delays in time to surgery, which is particularly important for urgent surgery such as AAA with a high predicted risk of rupture and colorectal surgery for malignancy, and also reducing costs by minimising the number of appointments required.

We made the following changes to our leaflet:

- 1) Highlighted the importance of eating 2 hours pre-test
- 2) Underscored the importance of good hydration including drinking water immediately pre-test
- 3) Added the option to chew gum during the test to keep mouth moist
- 4) Reinforced the need to commit fully to the test before starting e.g. making sure the patient is comfortable with the mask

Test 1	Test 2	1 <sup>st</sup> / 2 <sup>nd</sup> AT	1 <sup>st</sup> / 2 <sup>nd</sup> VO <sub>2</sub> peak	1 <sup>st</sup> / 2 <sup>nd</sup> VeqCO <sub>2</sub>	Comments
19/03/2012	09/07/2012	-- / 11	10 / 13	-- / 51	Mirtazapine SE: tachyarrhythmia
20/01/2014	03/02/2014	8 / 10	11 / 13	40 / 39	Ceased smoking
03/10/2011	10/10/2011	9 / 9	11 / 13	32 / 32	Took breakfast and metformin
30/04/2012	21/05/2012	17 / 12	25 / 16	35 / 34	Calibration error
12/06/2017	19/06/2012	10 / 15	14 / 21	41 / 40	Dry mouth: chewing gum
23/01/2017	05/06/2014	8 / 11	13 / 15	36 / 34	Mask intolerance
23/05/2016	15/08/2016	6 / 11	11 / 15	41 / 45	Exercise training

## Use of Novel Aspects of Cardiopulmonary Exercise Testing to Predict Complication Type Following the Open Repair of Abdominal Aortic Aneurysm

*Matthew D Walne, University of Sheffield*

Peak oxygen consumption (peak VO<sub>2</sub>) and anaerobic threshold (AT) measured during pre-operative cardiopulmonary exercise testing (CPET) have previously been shown to be associated with short term and long-term mortality following abdominal aortic aneurysm repair (AAA).[1] Nationwide reduction of post-repair mortality means morbidity may be a better marker of improved care. Use of CPET to identify the likelihood of complications may be valuable.[2] This retrospective study aims to ascertain whether pathological responses in CPET variables during exercise are associated with complication type in critical care.

CPET data collected prospectively prior to open AAA repair was reviewed to identify pathological responses of the cardiovascular and respiratory systems (including aspects of PETCO<sub>2</sub>, VO<sub>2</sub>/work rate relationship, O<sub>2</sub>-pulse trajectory and heart rate response). Each patients' critical care electronic record, which gathered data in real time, was examined to identify the occurrence of life-threatening complications. Multiple logistic regression was used to identify risk factors for complications of each organ system, while adjusting for intra-operative factors.

The study included 172 patients, with a mean age of 72.4 years, of whom 150 (87.2%) were male. Following open AAA repair, 7 (4.1%) patients died and 106 (61.6%) experienced complications of at least one organ system in critical care. Mortality was associated with a non-linear heart rate response (OR = 5.763; 95% CI: 1.197 – 27.741; p = 0.046). An increased peak O<sub>2</sub>-pulse as a percentage of predicted, was shown to be an independent predictor of cardiovascular failure (adjusted OR = 1.025; 95% CI: 1.004 - 1.046; p = 0.017). Respiratory failure could be independently predicted by a lower unloaded phase PETCO<sub>2</sub> (adjusted OR = 0.879; 95% CI: 0.775 – 0.998; p = 0.046) or in a separate model, higher VE/VCO<sub>2</sub> at AT (adjusted OR = 1.085; 95% CI: 1.007 – 1.169; p = 0.032). Acute kidney injury was independently associated with oxygen desaturations during CPET (adjusted OR = 5.693; 95% CI: 1.331 – 24.355; p = 0.019). Neurological complications were associated with a lower apex PETCO<sub>2</sub> (adjusted OR = 0.887; 95% CI: 0.808 – 0.974; p = 0.012)

This study provides evidence for the role of additional CPET variables in the prediction of cardiovascular, respiratory, renal and neurological complications, though these require further exploration.

### References

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2. Barakat H.M, Shahin Y, McCollum P.T et al. Anaesthesia. 2015; 70: 679-85

# **Post-Operative Health Related Quality of Life in Vascular Patients undergoing Complex Aortic Surgery using a novel SMS Patient Reported Outcome Measures Tool: A Service Improvement**

*Christine Sathanathan, Royal Free Hospital London NHS Foundation Trust*

Complex Aortic (CA) endovascular (EV) procedures are performed in high risk patients with multiple co-morbidities. Despite known high postoperative morbidity, long-term functional outcomes of EV techniques are unknown. Patient Reported Outcome Measures (PROMS) provide valuable information supplementing clinical outcomes such as the impact illness has on patients' lives outside hospital(1). PROMS have not commonly been studied in patients with complex arterial (CA) disease despite known high rate of post-operative complications.

Traditionally, PROMS have been measured using pen and paper techniques such as The European Quality of Life 5 Dimension (EuroQoL 5D) tool(2). This is a standardized instrument measuring Health related Quality of Life (HRQoL) assessing domains of mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The digitization of healthcare research enables the use of mobile technology, through text messaging (SMS) to deliver and collect clinically important information captured in real time allowing for continuous feedback and improvement such as PROMS specific to the CA patient.

At our institution, approximately 60 CA patients undergo EV procedures annually. Routine clinical data collected by the CA and Anaesthetic teams include mortality, morbidity, length of stay and readmission rates. No previous HRQoL data has been collected in this group. As PROMS are now considered a routine measure of quality of multidisciplinary team (MDT) care for feedback and staff education, we felt it was important to address this in a high risk patient group.

As part of Trust-wide service improvements, an automated SMS appointment service has recently been introduced aiding communication to patients in the outpatient setting. Taking advantage of this technology, we developed a novel SMS EQ-5D 3L (3 level) tool(2) that will enable collection of PROMs data on a high risk patient group and comparison of paper vs SMS delivery techniques allowing us to understand which PROMs tool delivery mode is more favourable to patients. Taken together, we hope to deliver a uniquely comprehensive Complex Aortic service. A randomised prospective study design (agreed upon by all stakeholders) has been granted ethical approval. All consenting patients (written) shall be sent either a paper or SMS questionnaire delivered at key postoperative intervals; weeks 6,12,26 and 52, with replies expected in the same format. We aim to analyse domain-specific and total PROMS scores and compare pre and post-operative PROMS scores to assess changes in HRQoL.

Regular PROMS analysis enables assessment of Quality of Care (QoC) and wider treatment effects on patients' HRQoL. We believe our study has a number of patient-centred advantages. Utilisation of PROMs data in consent conversations aids addressing patients' expectations of the impact of surgery on HRQoL and empowers them to make informed decisions on care. We believe this will improve patient experience and patient and staff knowledge on the effect of EV surgery on HRQoL.

Anticipated challenges include raising staff awareness of the importance of PROMs to sustain momentum for the duration of the study period. However, as we aim to track HRQoL over a year postoperatively, it is envisaged that the study will generate meaningful data in a high risk patient group, improving QoC and overall patient experience.

## References:

1. Holmes C, Briffa N. Open Heart.2016;3(1):e000315.
2. euroqol.org

## Post operative analgesic requirements and outcomes post complex aortic endovascular repair

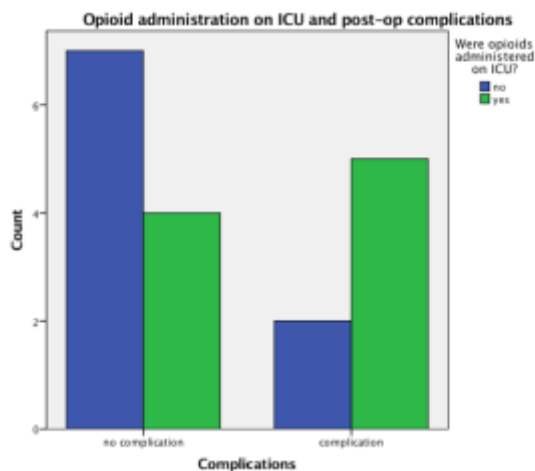
Ciara I Donohue, Royal Free London

Fenestrated endovascular repairs (FEVAR) enable minimally invasive management of complex abdominal aortic aneurysms in selected patients, potentially reducing physiological insult, haemodynamic instability, end organ damage, post operative complications and pain. Thus recovery may be enhanced compared with open procedures. An evaluation of postoperative analgesic requirements and complications was prompted by a critical incident in which a patient given postoperative opioids vomited, aspirated and had a hypoxic cardiac arrest.

An audit of 6 months of FEVARs performed at our institution was undertaken (February 2016 – September 2016). From a total of 19 patients, 17 patients had complete electronic records available for review. Data extracted included, intra and postoperative analgesic requirements (converted to equivalent doses of oral morphine), pain scores, any cause complication, ICU length of stay (LOS) and hospital LOS. Continuous non-parametric variables were expressed as medians with interquartile ranges [IQR] and compared using the Mann Whitney U test. Categorical variables were analysed using the chi squared test. A p value of <0.05 was considered statistically significant. Analysis was carried out using Microsoft Excel and IBM SPSS statistics version 24.

Intraoperative analgesic requirement was modest, with 4/17 patients receiving a remifentanyl targeted controlled infusion (TCI) and the majority receiving intermittent boluses of intravenous (IV) fentanyl (median total dose 350mcg [IQR 300-450mcg]). Most patients postoperatively received regular paracetamol and as-required opioids, the majority of which were not administered. 4 patients received spinal drains for perioperative spinal cord protection. These patients had higher median 1st 24 hour postoperative opioid requirements than those who did not have spinal drains (35mg equivalent dose of morphine [16.25-67] vs 0mg [0-20]) p=0.035. Patients who required >1 day postoperative ICU stay (n=6) had higher median 1st 24hr opioid requirements compared with those who were discharged within 24 hours (n=11) (20mg [12.5 – 42.5] vs 0mg [0-10] p=0.048. Dividing patients into those who had any documented complication (n=7) and those that did not (n=10) demonstrated a trend towards higher median 1st 24-hr opioid requirements (20mg vs 0 mg p=0.126), a tendency to higher post-operative pain scores (1.5 vs 0 p=0.18) and statistically significant increased ICU LOS (2.5 days vs 1 day p=0.007) and hospital stay (6.5 days vs 3 days p=0.05)

Significant post-operative pain should be uncommon following FEVAR and typical postoperative course involves a 24 hour ICU stay followed by discharge on day 3-4. The presence of pain and need for strong opioids post operatively may serve as an alert to an evolving complication and signify an adverse postoperative course with associated protracted recovery and hospital stay. Alternatively the administration of strong opioids may contribute to delayed recovery and discharge. Need for strong opioids post FEVAR now prompts a call to the complex aortic team and we are reviewing the impact of this intervention on postoperative analgesic requirements and outcomes.



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