

*Vascular Anaesthesia Society
of Great Britain and Ireland*

Annual Scientific Meeting

*Abstracts for
Exeter Meeting*

8th and 9th September 2016

*University of Exeter
Streatham Campus
Stocker Road
Exeter
EX4 4SZ*

VASCULAR ANAESTHESIA SOCIETY

Thursday 8th September 2016

Session 1: Under Pressure

- 11.15 - 11.40 **"Guideline Update: Measurement of Adult Blood Pressure and Management of Hypertension before Elective Surgery"**
Dr John Carlisle, Torbay
- 11.40 - 12.05 **"Strategies for Difficult Hypertension"**
Dr Andrew Sharp, Exeter
- 12.05 - 12.30 **"Intraoperative Management of Blood Pressure"**
Dr Simon Howell, Leeds

Session 2: Don't Go Breaking My Heart

- 1.45 - 2.10 **"Cardiac Imaging Beyond the Echo"**
Professor Nick Bellenger, Exeter
- 2.10 - 2.35 **"Functional Testing for the Vascular Patient"**
Dr Richard Struthers, Plymouth
- 2.35 - 3.00 **"Reducing Cardiovascular Risk in Vascular Surgery"**
To be confirmed

Session 3: Who Wants to Live Forever

- 3.45 - 4.10 **"The National Vascular Registry: What have we Learned so Far?"**
Professor Ian Loftus, London
- 4.10 - 4.35 **"Measuring Long-term Outcomes"**
Dr Ramani Moonasinghe, London
- 4.35 - 5.00 **"Long-term Outcomes of Aortic Surgery EVAR and Open Repair"**
Mr David Mitchell, Bristol

VASCULAR ANAESTHESIA SOCIETY

Friday 9th September 2016

Session 4: Nobody Does It Better

- 9.00 - 9.25 **"Perioperative Medicine: NICE Idea but Where is the Evidence"**
Dr Mike Swart, Torbay
- 9.25 - 9.50 **"Prehabilitation and Fitness for Surgery"**
Professor Gerry Danjoux, Middlesbrough
- 9.50 - 10.15 **"Perioperative Medicine – a Physicians Perspective"**
Dr Jugdeep Dhesi, London

Session 5: Research and Audit

11.00 - 12.00 **Free Paper Session**

"ACT guided Heparin Administration in Major Vascular Surgery"
Ben Jones, Brighton and Sussex Medical School

"Is preoperative exercise training feasible in patients with large abdominal aortic aneurysms?"
Durrand^{J1}, Weston^{M2}, Batterham^{A3}, Tew^{G4}, Kothmann^{E1}, Yates^{D5}, Danjoux^{G1}, 1. James Cook University Hospital 2. Teesside University 3. Teesside University 4. Northumbria University 5. York Teaching Hospitals NHS Foundation Trust

"Morbidity & Mortality at 5 Years Following Endovascular Aortic Aneurysm Repair in the West of Scotland"
Niall O'Reilly, P Moffit, I Raju, Queen Elizabeth University Hospital,

Glasgow

"Study of hypoxic conditioning using simulated altitude exposure as a means of improving cardiopulmonary functional capacity"
Brown LA, Griffiths JA, Santer P, Jakeman P, Smith TG, University of Oxford and John Radcliffe Hospital

"Haemoglobin concentration is associated with sarcopenia in patients presenting for elective endovascular aneurysm repair"
Noel Baskeran, University College London

12.00 – 12.45 **Case Discussion: "Lose a Limb not a Life?"**
Dr Elke Kothmann, Middlesbrough
Mr Adam Stannard, Middlesbrough
Dr Andrew Ludman, Exeter
Dr Richard Telford, Exeter
Dr Jugdeep Dhesi, London

Session 6: The Final Countdown

- 1.45 - 2.00 **"Prize Presentations"**
Dr Adam Pichel, Manchester
- 2.00 - 2.25 **"Surgical Management of Thoracic Outlet Syndrome"**
Mr J Thompson, Exeter
- 2.25 – 2.55 **"Anaesthetic Management of Thoracic Outlet Surgery"**
Dr Richard Telford, Exeter

"The Measurement of Adult Blood Pressure and Management of Hypertension Before Elective Surgery"

Dr John Carlisle

*Consultant in Anaesthesia, Critical Care and Peri-operative Medicine
South Devon and Torbay NHS Foundation Trust*

The AAGBI published this guideline in March 2016. The guideline was written following the standard AAGBI process: the formation of a guideline development group; a review of the evidence; writing of a sequence of draft guidelines; comments from AAGBI members on the guideline; amendment of guideline; publication of guideline.

This guideline was a joint enterprise with the British Hypertension Society (BHS), the input of which was equivalent to that of the AAGBI. This joint approach, with a society that predominantly represents the interests of primary care physicians, makes this particular guideline interesting and a model for future consensus.

This guideline aims to ensure that patients admitted to hospital for elective surgery are known to have blood pressures below 160 mmHg systolic and 100 mmHg diastolic in primary care. The objective for primary care is to fulfil this criterion before referral to secondary care for elective surgery. The objective for secondary care is to avoid spurious hypertensive measurements. Secondary care should not attempt to diagnose hypertension in patients who are normotensive in primary care. Patients who present to pre-operative assessment clinics without documented primary care blood pressures should proceed to elective surgery if clinic blood pressures are below 180 mmHg systolic and 110 mmHg diastolic.

"Functional Testing for the Vascular Patient"

*Dr Richard Struthers, Plymouth
Consultant Anaesthetist, Plymouth Hospitals NHS Trust*

General information:

Dr Struthers has been a Consultant Anaesthetist in Plymouth since 2002 is an Honorary Lecturer for Peninsula Dental and Medical Schools.

He is the Care Group Director for Surgery and was previously Lead for Planned Care Assessment. He has contributed to national guidance and policy on assessment before surgery.

Dr Struthers trained in the South West of England and the Midlands. He spent a year as a Consultant at the University of Michigan, USA doing both anaesthesia and research before returning to the UK.

Particular areas of expertise:

Dr Struthers has a research interest into predicting risk before surgery and changing care to improve outcomes. Previous research projects have looked at assessing fitness before surgery (including walking tests and exercise bicycle), changing the way we give intravenous fluids during surgery, looking at microvascular flow during and after surgery, peri-operative Oxygen consumption and how it impacts on recovery.

Summary

Vascular surgical patients are well known to be at high risk of complications after surgery – in part due to the high rates of comorbidity (smoking related disease and diabetes) and due to their inability to cope with the “stress of surgery”.

Identifying patients at increased risk before surgery should allow for pre-procedural optimisation, appropriate informed consent, and appropriate peri-operative care.

During the talk I aim to address the assessment of heart failure, and stable coronary artery disease (whilst recognising the previous speakers expertise) and our ability to identify those patients at risk of coronary plaque rupture and “failing to fly” after surgery –in particular the role of inflammation in these processes.

I also aim to demonstrate where our traditional non-functional testing may fail to identify patients at risk and where functional testing may be more valuable – and why this may be the case – particularly in assessing what role “fitness” has in survival.

References:

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2014;64(22):e77-e137. doi:10.1016/j.jacc.2014.07.944

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Ackland GL, Iqbal S, Paredes LG et al. Individualised oxygen delivery targeted haemodynamic therapy in high-risk surgical patients: a multicentre, randomised, double-blind, controlled, mechanistic trial. *Lancet Respir Med*. 2015 Jan;3(1):33-41. doi: 10.1016/S2213-2600(14)70205-X.

Silverman MN, Deuster PA. Biological mechanisms underlying the role of physical fitness in health and resilience. *Interface Focus*. 2014 Oct 6;4(5):20140040. doi: 10.1098/rsfs.2014.0040.

"Prehabilitation and Fitness for Surgery"

*Professor Gerry Danjoux, Middlesbrough
Consultant Anaesthetist, South Tees Hospitals NHS Foundation Trust*

Fitness for surgery and the concept of Prehabilitation have developed rapidly over the last 5 years. Several recent publications have highlighted the evolving association between preoperative levels of fitness and outcome following Abdominal Aortic Aneurysm (AAA) repair. The primary aim of this presentation will be to evaluate the evidence-base for preoperative exercise prior to AAA surgery.

This presentation will aim to cover the following areas:

- Prognostic significance of cardio-respiratory fitness in patients undergoing AAA repair
- Review of current evidence-base with respect to preoperative exercise initiatives aimed at improving outcomes following AAA surgery. This will be presented using a Scientific Assessment Framework covering a range of relevant studies from Proof of Concept through to recently published outcome studies
- Differing exercise strategies to improve aerobic fitness will be covered including outcomes from a recently completed study using High Intensity Interval Training prior to AAA repair for which the presenter was Chief Investigator (HIT-AAA study)
- Evaluating the safety of preoperative exercise initiatives and the concept of 'responders' and 'non-responders'.

FREE PAPER SESSION

“ACT guided Heparin Administration in Major Vascular Surgery”

Ben Jones

Medical Student, Brighton and Sussex Medical School

A recent audit of all major vascular surgical procedures at the Royal Sussex County Hospital recorded a thrombotic/ischaemic complication rate of approximately 10% which is in line with national data(1). In an attempt to reduce the risk of this complication, patients are routinely anticoagulated empirically with unfractionated heparin (UFH). However, the anticoagulant effect of UFH is highly variable between individuals; consequently many patients may not be adequately anticoagulated. Titration of UFH to individual patients using activated clotting time (ACT) monitoring could improve anticoagulation and reduce incidence of thrombotic complications.

After local Research and Development approval we conducted an observational study to assess the effect of the current heparin dosing regimen on the patients' ACT. We then assessed the feasibility and outcome of using an alternative heparin regimen based on a weight adjusted initial dose and ACT guided administration of additional doses, to maintain the ACT between 225 and 275s. The ideal level of ACT commensurate with lack of thrombosis and no increase in bleeding in major vascular surgery is not yet known. Additional doses were calculated using a linear extrapolation of the initial response of ACT to UFH. The outcome, with respect to bleeding and thrombotic complications of the two groups of patients undergoing primarily aortic and lower limb bypass procedures was compared.

The ACT-guided and empirical heparin groups included 17 and 19 patients, respectively. No thrombotic complication occurred in the ACT group whilst 2 patients (10.5%) in the empirical heparin group required embolectomy. This difference was insignificant due to small sample size. 1 patient in the ACT group returned to theatre for washout of a large haematoma. There were no major haemorrhagic complications in the empirical heparin group. 2 patients in the ACT group versus 4 patients in the empirical group had minor bleeding. There was no significant difference in incidence of major, minor, or all haemorrhagic complications.

The lower incidence of thrombotic complications in the ACT group suggests ACT-guided heparin therapy may be superior to empirical heparin therapy. The similar incidence of haemorrhagic complications suggests ACT guidance of heparin administration is safe. Limitations to this study include heterogeneity of procedures, small sample size and incomplete data for some patients. A recent systematic review of the use of heparin in Abdominal Aortic Aneurysm surgery has suggested that a randomised controlled trial (RCT) is required to answer the question: If, how much and how should heparin be given to prevent thrombotic complications in major vascular surgery(2)? This pilot study will help to inform the trial protocol for a large scale multi-centre RCT.

References

1. The Vascular Society of Great Britain and Northern Ireland. London: Royal College of Surgeons; 2009
2. Wiersema AM, Jongkind V, Bruijninx CM, et al. Eur J Vasc Endovasc Surg. 2012 Oct;44(4):359-67

“Is preoperative exercise training feasible in patients with large abdominal aortic aneurysms?”

Durrand^{J1}, Weston^{M2}, Batterham^{A3}, Tew^{G4}, Kothmann^{E1}, Yates^{D5}, Danjoux^{G1}

1. Department of Anaesthesia Research, James Cook University Hospital 2. School of Social Sciences, Business and Law, Teesside University 3. Health and Social Care Institute, Teesside University 4. Exercise and Health Sciences Department, Northumbria University 5. Department of Anaesthesia and Critical Care, York Teaching Hospitals NHS Foundation Trust

Interest has grown in the enhancement of pre-surgical fitness through exercise. Central to this is the effective and safe delivery of exercise interventions whilst ensuring patient engagement. HIT-AAA is a randomised controlled feasibility study of a 4-week cycle based high-intensity interval training intervention (HIT) in patients approaching surgery with large Abdominal Aortic Aneurysm (AAA) disease². We present an evaluation of the feasibility, fidelity and safety of the preoperative exercise intervention.

Methods:

Twenty-seven trial participants were randomised to preoperative exercise. Following baseline cardiopulmonary exercise testing (CPET), participants attended three HIT sessions weekly comprising: 16 minutes of high intensity exercise as 8 × 2 minute intervals or 4 × 4 minute intervals interspersed with matching recovery periods. Patients encountering surgical delay undertook a single weekly ‘maintenance’ session. HI repetition power targets were set to anaerobic threshold then adjusted to achieve ratings of perceived exertion (CR-10 scale) for both ‘legs’ (RPE-L) and ‘breathlessness’ (RPE-C) of ‘hard’ (5) to ‘very hard’ (7). Physiological safety limits were set at systolic BP ≥ 180 mm Hg or heart rate ≥ 95% of maximum observed on CPET. A ‘compliant’ participant completed ≥75% of the scheduled sessions and all required maintenance sessions. Analysis of achieved intensity was restricted to compliant participants.

Results:

206 HIT sessions were performed. Mean session attendance in the 4-week intervention phase was 74% (range 0 – 100%) with 20/27 participants attending ≥ 75% of sessions. Fifteen participants encountered surgical delay, requiring maintenance sessions. A total of 40 maintenance sessions were prescribed with 36 (90%) of these sessions attended. The mean number of required maintenance sessions was 1 (range 1 to 9). Overall, 63% (n= 17) of participants met the compliance criteria attending a mean of 11 sessions (range 9 to 12) during the 4-week intervention and 1 (range 0 to 4) maintenance session. Mean HIT repetition intensity was 4.1 ± 2.0 (arbitrary units [AU]) for RPE-L and 3.5 ± 1.9 AU for RPE-C with the proportion of repetitions meeting our high-intensity criterion being 30% (RPE-L) and 16% (RPE-C). When compared to initial sessions, final exercise sessions achieved substantially higher power outputs: 8 Watts (90% confidence interval ± 4W), a mean 13.1% increase. We observed one adverse event.

Conclusions:

The substantial majority of this high-risk patient group attended the prescribed preoperative exercise programme. Despite exercising at lower than targeted intensity, we have demonstrated that patients with large AAA disease can exercise at moderate to hard intensities, with a low adverse event profile observed.

1. Snowden CP et al. Exercise: The new premed. BJA. 2015

2. Tew G et al. High-intensity interval exercise training before abdominal aortic aneurysm repair (HIT-AAA): protocol for a randomised controlled feasibility trial. BMJ Open. 2014

“Morbidity & Mortality at 5 Years Following Endovascular Aortic Aneurysm Repair in the West of Scotland”

*Niall O'Reilly¹, P Moffit,² I Raju³,
Specialist Trainee Registrar¹, Medical Student², Consultant Anaesthetist³
Queen Elizabeth University Hospital, Glasgow*

Endovascular aortic aneurysm repair (EVAR) is offered to patients who have an aortic aneurysm > 5.5cm with suitable anatomy & in patients with co-morbidity that preclude open repair. The EVAR 1 study showed a 3-fold reduction in operative mortality compared to open repair [1] but this early benefit is not translated into long-term survival [2].

Endoleaks are a complication of EVAR & the National Vascular Registry 2015 report states the incidence at 1 year of Type I endoleaks is 4.5% & Type II endoleaks is 9.9% with 132 requiring intervention [3]. The aim of this data review was to assess 5-year mortality post-EVAR, cause of death & prevalence of procedural related complications & re-intervention. We retrospectively reviewed the electronic records of 93 patients who underwent EVAR between 2/2/2010 - 26/7/2011 in Greater Glasgow & Clyde Health board area using Orion Health Clinical Portal system.

The 1 year mortality was 5.4% [n=5] & 5 year mortality was 22.6% [n=21] in our cohort. All patients were above 70 years old. Causes of death included 5 patients from malignancy, 3 from pneumonia, 2 from intra-cerebral events, 2 from aneurysm related mortality, 2 from myocardial infarctions, 1 from urosepsis, 1 from an ischaemic limb, & 5 unknown. Of the 5 deaths within 1 year of EVAR, 1 was from pneumonia 12 days post EVAR, 2 from metastatic malignancies found after EVAR, 1 from a myocardial infarction & 1 after presenting with acute abdominal pain.

41 EVAR related complications in 36 (38.7%) patients were identified for the 5 year period. There were 9 Type I endoleaks, 18 Type II endoleaks, 2 Type III endoleaks, 11 stent occlusions & 1 stenosis. 27 separate therapeutic re-interventions were undertaken in 22 patients. Of these, 7 were femoral crossover grafts, 6 embolisations, 5 angioplasties, 3 cuff insertions, 2 aorto-bifemoral grafts, 1 axillo-bifemoral graft, 1 femoral endarterectomy, 1 cuff repair & 1 open repair.

The results demonstrate that EVAR is associated with a considerable 5-year all cause mortality with only 10% of these being aneurysm related. There were a number of procedural related complications at 5 years, with 41 identified in our cohort. 24% of the patients needed some form of re-intervention with the majority being undertaken within 1 year of an EVAR. The incidence at 1 year of Type I endoleaks was 6.5% & Type II was 13.9% which at 5 years increased to 9.6% & 19.4% respectively.

Within the limitations of a retrospective data review of a small patient cohort, the results show that an EVAR offers early outcome benefits however the incidence of long-term morbidity & repeat procedures is not insignificant hence demonstrating that EVAR is not the complete solution. EVAR will still remain the treatment of choice for aortic aneurysms where clinically appropriate but we have to be honest when informing our patients of the long-term sequelae of an EVAR.

References

1. The United Kingdom EVAR Trial Investigators, Endovascular versus Open Repair of Abdominal Aortic Aneurysms, *New England Journal of Medicine* 2010;362: 1863 - 1871
2. Brown LC, Powell JT, Thompson SG, Epstein DM, Sculpher MJ, Greenhalgh RM. The

UK EndoVascular Aneurysm Repair (EVAR) trials: randomised trials of EVAR versus standard therapy. Health Technol Assess 2012;16(9)

3. Vascular Society of Great Britain & Ireland. National Vascular Registry 2015 Report <http://www.hqip.org.uk/public/cms/253/625/19/323/NVR%202015%20Annual%20Report.pdf?realName=r1PhgZ.pdf>

“Study of hypoxic conditioning using simulated altitude exposure as a means of improving cardiopulmonary functional capacity”

*Brown LA, Griffiths JA, Santer P, Jakeman P, Smith TG
University of Oxford and John Radcliffe Hospital*

Perioperative morbidity and mortality is a major problem for patients facing major surgery, including vascular surgery, and is associated with poor levels of fitness demonstrated on preoperative cardiopulmonary exercise testing (CPET). Encouraging studies are currently exploring the potential for exercise ‘prehabilitation’ as a means of intervening preoperatively to improve fitness and modify a patient’s risk once it has been identified on CPET. Exposure to simulated altitude may offer an alternative means of improving cardiorespiratory fitness in this setting, either as an adjunct to exercise or for patients who are not suitable candidates for an exercise programme. Altitude training is well established for athletes, and even the elite can improve their performance with exposure to mild hypoxia through short-term residence at altitudes of ~ 8,000 ft (2,438 m). Benefits are likely to be easier to achieve when baseline fitness is low, as is the case in many patients. The concept of using hypoxia to condition patients preoperatively has not yet been explored but would be attractive clinically if it were to have sufficiently favourable effects on morbidity, mortality and healthcare costs.

This study investigated the potential to improve cardiorespiratory fitness using simulated altitude in eight older volunteers (mean age 64 yr) who were sedentary and unfit. The study used a randomised, double-blind, sham-controlled crossover design and was conducted at the Irish National Altitude Training Centre, a unique residential hypoxia facility at the University of Limerick. Participants spent two separate weeks in the facility: one week with normal air and one week with mild hypoxia (15% oxygen) similar to an airline flight (equivalent to an altitude of ~8,000 ft). CPET was conducted before and after each week.

Overall, the results did not support a clinically useful effect of this approach. For both the normoxic and hypoxic weeks, oxygen consumption (VO₂) at anaerobic threshold was 12 ± 1 ml/kg/min at the beginning of the week and 11 ± 1 ml/kg/min at the end of the week. This change was not statistically significant in either the normoxic ($P = 0.2$) or hypoxic ($P = 0.3$) weeks, and there were no effects on other standard CPET variables at anaerobic threshold. Peak VO₂ was unaffected by residence in the facility or by hypoxia, although some peak variables were increased at the end of the hypoxic week compared with the beginning, including duration of test (increased by 31 ± 11 sec; $P < 0.05$), maximum work rate (116 ± 16 W compared with 105 ± 12 W; $P < 0.05$) and peak heart rate (130 ± 5 bpm vs 113 ± 10 bpm; $P < 0.05$). However, none of these differences were statistically significant when compared with the control week data.

Conditioning with one week of mild hypoxia in a simulated altitude setting had no effect on CPET variables that have been associated with perioperative outcomes. Although there was an indication that participants were able to exercise longer and harder following a week of hypoxia, these changes were not statistically significant overall when compared with the control week, possibly reflecting a lack of power to detect such subtle effects in this initial study. Further studies of hypoxic conditioning in this context could explore the use of greater ‘doses’ of hypoxia or intermittent hypoxia.

Funding: Clinical Lecturer Starter Grant from the Academy of Medical Sciences.
ClinicalTrials.gov Identifier: NCT02523716

“Haemoglobin concentration is associated with sarcopenia in patients presenting for elective endovascular aneurysm repair”

Noel Baskeran

Medical Student, University College London

This retrospective, observational study aimed to determine whether a relationship exists between haemoglobin concentration (Hb) and sarcopenia in patients scheduled for elective endovascular aneurysm repair (EVAR). Sarcopenia, the progressive loss of core muscle mass and function is a component of a multi-factorial process leading to frailty with advancing age. It is calculated using a well-validated technique of measuring total abdominal muscle area (TAMA) on computed tomography (CT) images (1). Sarcopenia is an independent predictor of worse surgical outcomes (2), which has particular relevance for this elderly, frail cohort; but measuring it remains predominantly confined to research due to the need for specialist training and equipment. A surrogate marker like Hb could make sarcopenia clinically useful.

136 preoperative CT scans of 133 patients undergoing EVAR surgery (infrarenal, fenestrated complex and thoracic repairs) were reviewed alongside laboratory Hb and haematocrit (HCT) results, taken during routine pre-operative assessment. These blood tests were taken prior to any transfusion management that may have been required for pre-operative anaemia. TAMA was measured in mm squared using “SliceOmatic” software at the 3rd lumbar vertebra level (L3) on CT images. Hounsfield Units were measured using “Carestream” with 3 measurements taken at each psoas muscle at L3. “R”, “MedCalc” and “Excel 2013” were used for statistical tests. Linear regression and a student’s t test were performed on the data. (Sarcopenia was characterized as under 1 SD below the mean of the cohort, <131, n=26). The mean age of the cohort was 75.

Results show sarcopenia to significantly correlate with Hb ($p<0.0001$) and HCT ($p<0.0001$), with a 10g/L increase of Hb resulting in a 6.609 increase in mm³ in TAMA. There was over 15g/L difference in mean Hb between sarcopenic and non-sarcopenic patients (figure 1). There was also an association between lower Hb, sarcopenia and longer postoperative length of stay (LOS) ($p=0.07$).

The significant correlation found between low Hb and sarcopenia is intuitive. Both anaemia and sarcopenia are linked to poorer physiological states and worse outcomes (2, 3). The association between Hb and LOS, although not significant in this study, could be useful in targeting those who may require intensive pre-optimisation. Given the strength of association and ubiquitous nature of Hb testing, Hb has the potential to become a surrogate marker for sarcopenia in routine clinical practice. Further studies could explore whether augmenting red cell count preoperatively with iron supplementation – intravenous or oral - has an observed effect on muscle strength or mass. If a simple surrogate marker like Hb could alert clinicians to higher-risk patients, sarcopenia could transition from a predominantly research-based tool, to a clinical one. A pre-operative risk scoring system that incorporates anaemia, frailty (including sarcopenia proxied by Hb) and cardiorespiratory fitness may be useful in predicting those who are high risk for elective aortic surgery.

References

1. Cruz-Jentoft AJ, Baeyens JP, Bauer JM et al. Age Ageing. 2010; 39: 412-23
2. Joglekar, S, Asghar, A, Mott, SL et al. J. Surg. Oncol. 2015; 111: 771–5
3. Cesari M, Penninx BW, Lauretani F, et al. J Gerontol A Biol Sci Med Sci. 2004; 59:249–254.

Thanks to the Friends of University College London Hospitals for funding for the SliceOmatic Software

"Anaesthetic Management of Thoracic Outlet Surgery"

Dr Richard Telford, Exeter

INTRODUCTION

Thoracic outlet syndrome (TOS) refers to a cluster of symptoms caused by compression of the neurovascular bundle of the upper limb as they pass between the uppermost rib and clavicle en route to the axilla. Precise symptoms depend on the component affected – the brachial plexus, subclavian artery or subclavian vein – giving rise to neurogenic, arterial or venous TOS, respectively.

AETIOLOGY

Compression of the neurovascular bundle can be caused by congenital or acquired soft tissue and bony abnormalities. (table 1)

Any process that narrows the passage through which these important neurovascular structures pass can lead to symptoms of thoracic outlet syndrome. Major locations of compression of the neurovascular structures include over the first rib, behind pectoralis minor and within the scalene muscle triangle.

Table 1. Causes of thoracic outlet syndrome

Skeletal Factors (30%)	Soft Tissue Abnormalities	
	Congenital	Acquired
Cervical rib (figure 1 & 2)	Fibrous bands	Post-traumatic fibrous scarring
Elongated C7 transverse process	Variations in scalene muscle insertion	Post-operative scarring
Exostosis / tumour of 1 st rib or clavicle	Supernumerary muscles	Space-occupying lesion (Pancoast's tumour, cysts)
Excess callus following fracture of 1 st rib or clavicle		Soft tissue inflammation
Bifid clavicle		Hypertrophic muscles (athletes, swimming)
1 st / 2 nd rib fusion		Poor posture and weak muscular support



Figure 1. Chest radiograph showing bilateral cervical ribs



Figure 2. 3D CT reconstruction demonstrating a cervical rib with a small subclavian aneurysm located just distal to the tip of the cervical rib.

RELEVANT ANATOMY

The relations of the thoracic outlet are the body of T1 posteriorly, the medial borders of the first ribs laterally and the superior border of the manubrium anteriorly (figure 3). It transmits the oesophagus, trachea, thoracic duct, phrenic, vagus and recurrent laryngeal nerves, sympathetic trunks, common carotid and subclavian arteries, internal jugular, brachiocephalic and subclavian veins.

The brachial plexus emerges between scalenus anterior and scalenus medius, superior to the thoracic outlet, and runs over the first rib into the axilla. It is accompanied by the subclavian artery, which becomes the axillary artery at the lateral border of the first rib.

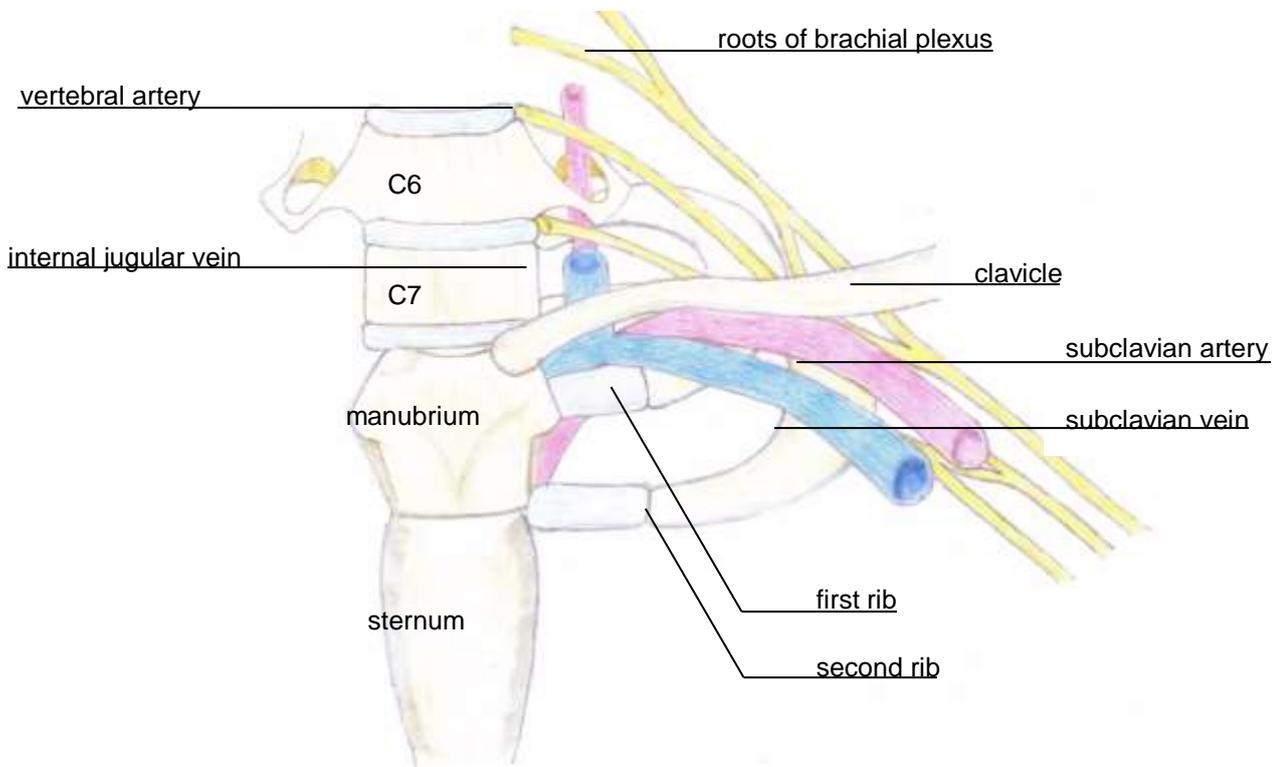


Figure 3. Anatomy of the thoracic outlet, demonstrating subclavian artery, vein and brachial plexus passing between the clavicle and first rib

INCIDENCE

TOS most commonly affects young females aged between 20 and 40 years of age, with a 4:1 female to male preponderance. Traumatic causes of thoracic outlet syndrome have an equal sex distribution.

CLINICAL PRESENTATION & DIAGNOSIS

Neurogenic

This refers to compression of the brachial plexus (figure 4), and accounts for the majority of cases of TOS, with symptoms reflecting the nerve roots involved. Symptoms do not follow a dermatomal distribution, distinguishing TOS from radicular nerve pathology.

90% of cases involve the C8 and T1 nerve roots causing pain and paraesthesia in an ulnar nerve distribution and wasting of abductor pollicis brevis, the hypothenar eminence and interossei.

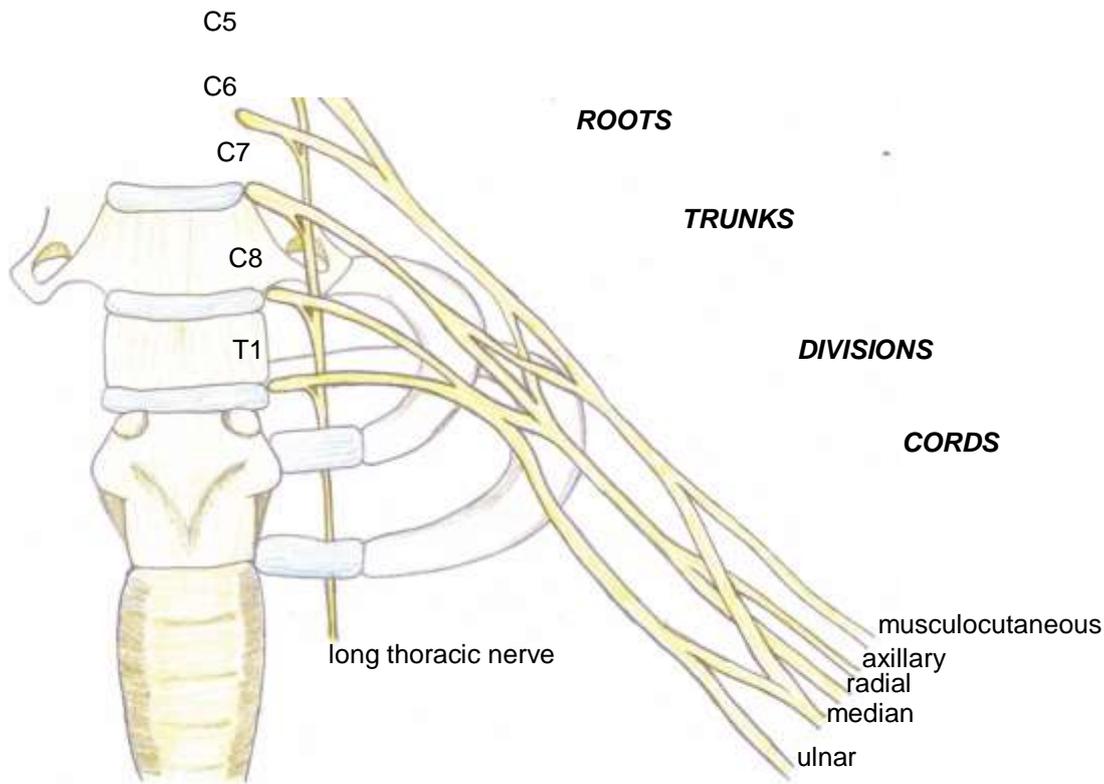


Figure 4. Brachial plexus

Involvement of C5, C6 and C7 causes pain referred to the upper chest, neck, ear and outer arm. Radial nerve symptoms can also be present.

Symptoms of sympathetic dysfunction, including cold extremities, Raynaud's phenomenon and trophic changes may occur.

Nerve conduction studies can play a useful role in helping make the diagnosis, but can be normal.

Arterial

This is more often seen in patients with a history of arm overuse (e.g. painters, mechanics, swimmers, rowers). Subclavian artery compression causing arterial TOS can lead to pallor, claudication, coldness and paraesthesia. Post-stenotic aneurysm or dilatation, producing a palpable supraclavicular fossa mass, may be seen with distal embolisation from mural thrombus producing brachial ischemia.

Diagnosis is made with a combination of arteriography (figure 5), ultrasound, CT or MRI imaging.



Figure 5. Arteriography demonstrating subclavian artery aneurysm in a patient with a cervical rib

Venous

Venous TOS causes swelling and congestion of the arm. Cyanosis, pain in the arm and venous distension over the shoulder and chest may be present. Paraesthesia can occur, and is due to swelling rather than nerve compression.

Venous TOS can be thrombotic (Paget-Schrotter Syndrome or effort thrombosis) or non-thrombotic. Thrombotic venous TOS commonly follows strenuous upper body exertion whereby repetitive compression of the subclavian vein causes intimal damage, activating the clotting cascade causing acute venous thrombosis. 10% of patients may develop pulmonary emboli.

Diagnosis is made by venography (figure 6).



Figure 6. Venography demonstrating subclavian vein thrombosis need to mark thrombosis with an arrow – not the “meniscus” in the subclavian vein

TREATMENT

Management ranges from conservative with advice regarding posture, physiotherapy and multimodal analgesia to surgical intervention. Surgical management can vary from excision of soft tissue or bony abnormalities to complex vascular reconstructions sometimes involving bypass grafts.

The transaxillary route is suitable for removal of the first rib in uncomplicated arterial and venous TOS and removal of the first rib. A cervical rib can also be removed using the transaxillary approach, but the first rib must be removed first in order to gain safe access. The supraclavicular approach is necessary for complicated arterial cases, e.g. subclavian aneurysms, and cases of neurogenic TOS which require exploration of the brachial plexus or removal of a cervical rib or band. The first rib can also be removed by the supraclavicular route.

Neurogenic

Physiotherapy and multimodal analgesic techniques play an important role in the management of neurogenic TOS. Surgical exploration of the brachial plexus may be considered, especially if abnormal anatomy is thought to be the cause of nerve compression or there is evidence of neurological deterioration (muscle weakness or wasting).

Arterial

Mild ischaemia may be amenable to physiotherapy. Acute brachial ischaemia may require urgent surgical decompression and immediate revascularisation. This may be achieved by thrombolysis or thrombectomy. Subclavian arterial reconstruction may be required for occlusive or aneurismal lesions.

Venous

Venous TOS is managed with thrombolysis in the first instance (figure 7), followed by anticoagulation with heparin until surgical decompression by resection of the first rib can be undertaken. Balloon venoplasty is performed 2 -3 weeks post operatively to maintain vein patency (figure 8).

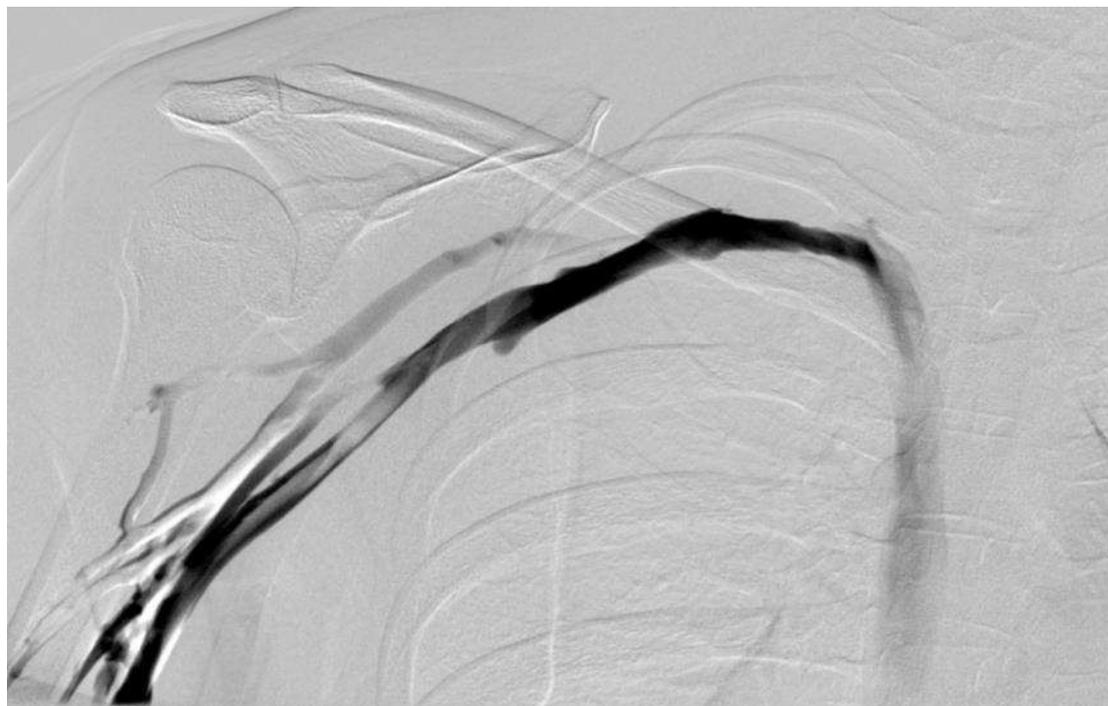


Figure 7. The same patient as figure 6 demonstrating resolution of subclavian vein thrombosis following thrombolysis

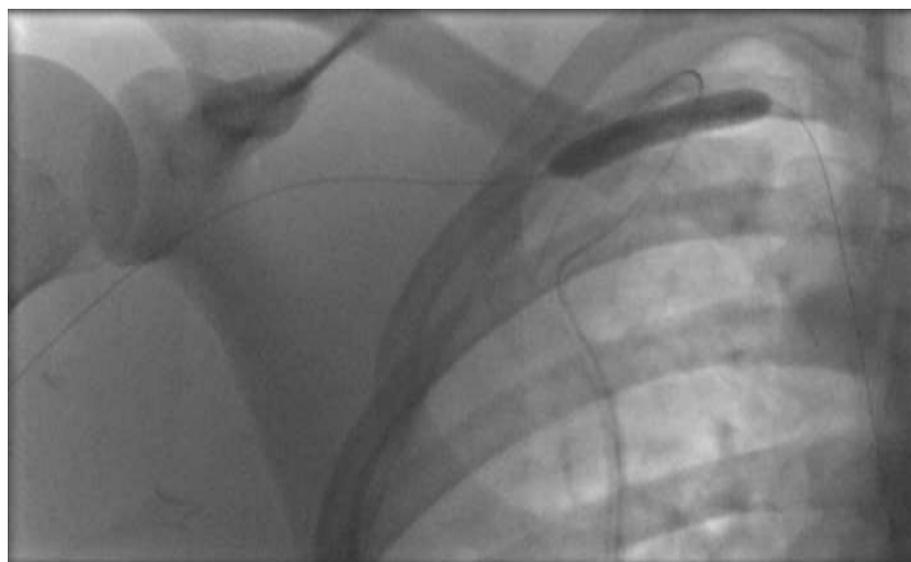


Figure 8. Subclavian venoplasty

ANAESTHETIC CONSIDERATIONS

Pre-operative Assessment

A majority of patients are young with minimal comorbidity. A group and save should be available.

Anaesthetic Technique

The patient is placed supine with a roll between the scapulae for the supraclavicular approach.

For the transaxillary approach, the patient is placed in a lateral position with the operative side uppermost. Surgical access may be challenging; the arm must be abducted to create enough space in the axilla to successfully excise the first rib.

Large bore venous access is required due to the risk of haemorrhage from the subclavian vessels. Air embolus can also occur.

A high-dose opiate, low-dose hypnotic balanced anaesthetic technique is suggested.

Neuromuscular blocking drugs should be avoided in complex cases where a nerve stimulator may be used.

The apical pleura can be breached with first rib resection.

Invasive monitoring is seldom required.

A superficial cervical plexus block can provide cutaneous analgesia when the supraclavicular approach is used, otherwise local anaesthetic infiltration of the wound should be used. Paravertebral blockade can be considered.

Post-operative Care

Surgery is painful and patients should be prescribed regular simple analgesics combined with patient-controlled analgesia.

An erect chest x-ray should be performed in recovery to exclude a significant pneumothorax and haemothorax on the operative side.

Patients should be monitored closely for signs of ongoing, insidious blood loss into the thoracic cavity.

Due to the breach in the apical pleura, blood may accumulate in the thoracic cavity rather than in the drain. This can necessitate a return to theatre for video-assisted clot evacuation, or thoracotomy in severe cases.

Patients are usually discharged 2 to 3 days post-operatively and advised to maintain shoulder and cervical spine mobility but avoid strenuous exercise or loading until physiotherapy follow-up.

VASCULAR ANAESTHESIA SOCIETY

Poster Presentations

Introduction of a Guideline for the Management of Haemodynamic Instability following Carotid Endarterectomy at the South Mersey Arterial Centre

E Perritt, K Savjani, F Saleem, L Wilson, Countess of Chester

Perioperative management of patients undergoing emergency EVAR. Standardising best practice through evidence based checklists.

Dr Rob Wiltshire and Dr Elisa Dedola, Specialty Registrar in Anaesthesia, University Hospital Southampton NHS Foundation Trust, Locum Consultant in Anaesthesia, University Hospital Southampton NHS Foundation Trust.

Lower Limb Amputations: How do we measure up? An audit of current practice in a tertiary referral centre

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Patient positioning during regional carotid endarterectomy using the Oxford HELP pillow

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Observation of current practice of the peri-operative care of lower limb amputation patients with a view to create a care pathway

Laith Malhas, University Hospitals Coventry and Warwickshire

The management of lower limb amputation in a tertiary centre

Peter Paisley¹, Sally Jeffrey², I Raju³, Specialist Trainee, Glasgow Royal Infirmary¹, Specialist Trainee, Queen Elizabeth University Hospital, Glasgow², Consultant Anaesthetist, Queen Elizabeth University Hospital, Glasgow³

An audit of perioperative management of diabetic patients undergoing non-emergency vascular surgery

Sarah Sullivan, Queen Elizabeth University Hospital, Glasgow

Intra-operative Blood Loss During Complex Endovascular Aneurysm Repair

Alistair Burns, Birmingham Heartlands

Adherence to an enhanced recovery protocol (ERP) for patients undergoing endovascular aneurysm repair (EVAR)

Gemma Nickols, Southmead Hospital, North Bristol NHS Trust

Challenges faced in the preoperative management of a complex ruptured abdominal aortic aneurysm with an aorta-caval fistula

Dr. Reema Ayyash, James Cook University Hospital

Audit of post-operative blood pressure management in carotid endarterectomy patients following introduction of a recovery guideline

Dr K Nickell, North Bristol NHS Trust

An evaluation of using Thrombelastography® Platelet Mapping™ to monitor platelet inhibition by aspirin and clopidogrel

Aayushi Gupta, Medical Student, University College London

Fluid warming in vascular surgery: Can the tendering process affect clinical practice?

Dr. Caroline Curry, Royal Victoria Hospital Belfast

Delayed presentation of critical upper limb ischaemia following brachial arterial line placement in a grandmultiparous lady.

Jenna Stevens, Royal Gwent Hospital

Post-operative analgesia following lower limb amputation – An audit of current practice at a tertiary vascular centre

Dr Katie Ayyash, York Teaching Hospitals NHS Foundation Trust

Building in Safety & Design for the new ‘Hybrid’ Theatre Era – Beyond the ‘Nuts & Bolts’ (a qualitative analysis)

Dr Aynkaran Dharmarajah, Northwick Park Hospital

An audit looking at adherence to safe radiation exposure levels to Anaesthetists during Endovascular Aortic Repairs in a new Hybrid Theatre

Dr Katie Gott, Manchester Royal Infirmary

Peri-operative hypotension in patients presenting with ruptured abdominal aortic aneurysms

Dr. Hazel Rooney, Southmead Hospital

Nickel allergy in EVAR: Survey of current practice and literature review

Dr. Clare McNulty, Hairmyres Hospital, Lanarkshire

Introduction of a Guideline for the Management of Haemodynamic Instability following Carotid Endarterectomy at the South Mersey Arterial Centre

E Perritt, K Savjani, F Saleem, L Wilson, Countess of Chester

Carotid endarterectomy (CEA) is indicated in patients with significant carotid artery stenosis to reduce the risk of fatal or disabling stroke. Haemodynamic instability in the perioperative period is common, and may contribute to cardiovascular, neurological and wound complications (1). There is little consensus on blood pressure thresholds for treatment following CEA (2). At the South Mersey Arterial Surgery (SMART) Centre, it was decided that a post-operative blood pressure guideline would be useful. The aim of the guideline was to clarify and standardise blood pressure management, increase confidence in the management of haemodynamic instability post-CEA, and improve patient outcomes.

A flowchart was developed, adapted from guidance published in the British Journal of Anaesthesia (1) and with feedback from SMART Centre Vascular Anaesthetists. Following introduction of the guideline, a case note review of CEA cases was performed, to investigate guideline usage and establish what impact there was on use of vasoactive drugs before and after guideline introduction.

The guideline was considered in 65% of cases, with improved use amongst anaesthetists based at the SMART Centre (77% vs 39%). In 47% of cases, a vasoactive drug was used for haemodynamic control, and 74% of these used the guideline. The majority of patients (85%) had their vasoactive drug discontinued within 24 hours. Following the introduction of the guideline there has been a significant increase in the use of vasoactive drugs post CEA ($p=0.027$).

We have developed a flowchart which includes strategies for the management of haemodynamic instability following CEA, and following initial introduction it is being used in 65% of cases. There has been a significant increase in the use of parenteral vasoactive drugs since the guideline was introduced. It was not used in the two patients who had to return to theatre for wound haematoma, which supports the argument that close control of blood pressure improves patient outcomes. Further work needs to focus on improving use of guideline and assessing further the impact on patient outcomes.

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Perioperative management of patients undergoing emergency EVAR. Standardising best practice through evidence based checklists

Dr Rob Wiltshire and Dr Elisa Dedola, Specialty Registrar in Anaesthesia, University Hospital Southampton NHS Foundation Trust, Locum Consultant in Anaesthesia, University Hospital Southampton NHS Foundation Trust.

The options for definitive management of a ruptured abdominal aortic aneurysm (AAA) include open or endovascular repair (if the aortic morphology and the patients' characteristics are suitable). The endovascular repair offers a cost effective[1] solution associated with a shorter length of hospital stay and no significant difference in mortality at 30 days¹ and one year² compared with the open surgical alternative. Furthermore, there is a four-fold survival benefit in endovascular repairs performed under local anaesthesia compared with general anaesthesia[2].

Patients who have a ruptured AAA are often critically unwell and as such place a high workload on healthcare teams in the resuscitation room, theatre and intensive care. Furthermore, patients often present out of hours when the expertise of a dedicated vascular anaesthetic team may not be available.

With this in mind, we have designed a 'check list' style evidence based guideline for patients who present to our institution. The guideline details the key elements of preoperative resuscitation, optimisation, intraoperative physiological and haematological goals as well as an approach to resuscitation, blood transfusion and permissive hypotension in the preoperative phase. There is also a suggested strategy for conversion to general anaesthesia if clinically indicated.

Checklists have an established and crucial role in the operating theatre and there is evidence that checklists may have further applications in emergency clinical scenarios[3]. We believe that this guideline will provide an evidence based framework to aid management of this group of patients who undoubtedly present an anaesthetic, surgical and radiological challenge.

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Lower Limb Amputations: How do we measure up? An audit of current practice in a tertiary referral centre

Dr. Caroline Curry, Royal Victoria Hospital Belfast

Major lower limb amputations (MLLAs) represent a challenging 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 is an ongoing prospective audit from 1st August 2015. Cases are identified using the theatre management system and patient charts reviewed. Data is collected on demographics, timing of surgery, cancellations, grade of surgeon and anaesthetist, anaesthetic technique, pain team involvement and diabetes management. Postoperative complications are identified by patient's discharge letter and follow up carried out at 30 and 90 days using the Northern Ireland Electronic Care Record.

By 10th June 2016 100 major lower limb amputations had taken place on 91 patients and 79 sets of patient notes have been reviewed. 60.7% are male and an age range of 30 to 99. Only 11.4% were seen at our vascular pre-assessment clinic despite 31.6% being planned admissions. 51.8% of the patients were diabetic. Only 16.6% of those on insulin were seen by a diabetic team preoperatively, only 54.2% commenced on a fasting protocol. 57% of patients had surgery within 48 hours of the decision and once booked on a theatre list 24% had their operation cancelled at least once. However 88.6% of amputations were done Monday to Friday in normal working hours and 77.2% took place on a dedicated vascular list. The case was carried out by a consultant anaesthetist in 92% of cases and in 77% the consultant surgeon was operating or present in theatre. Nine different antibiotic combinations were used in the 79 cases with only 27.8% adherence to our local policy. 44% of patients had a haemoglobin of less than 100 g/dL and 16.5% required intra-operative transfusions. 67.7% of amputations were carried out under general anaesthetic, 38% received a regional block for postoperative analgesia and sciatic nerve or wound catheters were used in 64.6%. Despite a good acute pain service only 3.8% of the patients were referred preoperatively and 34.2% postoperatively. Only 7.7% of patients not already on gabapentin or pregabalin were commenced preoperatively. 12.7% of MLLAs remained an inpatient on the vascular ward at 30 days with average stay of 20.2 days and the 30 day mortality rate was 7.6%. By 90 days 67.7 % of patients were in their home or nursing home.

Centralisation of services creates pressure on resources and running a tertiary referral service requires coordination. Our centre's mortality rates are lower than the NCEPOD findings but still higher than the 5% target. This audit highlights the need for a care bundle or pathway to better manage diabetes, anaemia and pain in the peri-operative period. The introduction of a pain management protocol would encourage use of regional blocks and involvement of the pain team. A review is currently under way of our antibiotic prophylaxis in vascular surgery and a recently commenced trust theatre quality improvement project aims to increase theatre efficiency and reduce cancellations.

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A Rare but Significant Complication Following Thoracic Endovascular Repair Leading to a Service Quality Improvement Project in a Vascular Teaching Unit

Dr Katie Ayyash, York Teaching Hospitals NHS Foundation Trust

Introduction

Spinal cord ischaemia (SCI) is a devastating and unpredictable complication of endovascular aortic aneurysm repair, with an incidence of 1-4% for endovascular thoraco-abdominal aneurysm repair (TAAA) [1]. Patients with neurologic deficit resulting from SCI have a perioperative mortality rate of 46% [2]. Potential mechanisms include critical interruption of the spinal cord blood supply by coverage of the feeder vessels, perioperative hypotension, and atheromatous embolisation [3]. We report a case of acute neurological injury as a result of a complication following TAAA that was not altered by spinal drain insertion.

Report

A 65-year-old male with a history of a previously ruptured infra-renal AAA repair and hypertension, underwent an uncomplicated thoracic endovascular repair of a 7cm type 4 thoraco-abdominal aneurysm involving the major visceral vessels with an abdominal branch graft. His systolic blood pressure (SBP) and mean arterial blood pressures (MAP) were maintained >100mmHg and >75mmHg respectively in the perioperative period. He was discharged home 2 days post-procedure. One-week later, he presented acutely with collapse, profound hypotension (SBP <70mmHg, despite fluid resuscitation) and paraplegia. A CT scan showed a peri-renal haematoma (Figure 1). He underwent an emergency renal artery embolisation, which was successful. A spinal drain was inserted post procedure (level L2/3). Despite continuous CSF drainage and maintaining a CSF pressure <10mmHg, there was no resolution of sensory or motor deficits. He was subsequently discharged to the neurology rehabilitation centre and is continuing to make a good recovery.

Conclusion

Several factors are associated with SCI after TAAA repair including: previous aortic surgery, length of aorta covered, and profound hypotension. In this case, SCI was probably secondary to a late bleed from a pseudo-aneurysm of a renal artery branch (wire induced) causing profound hypotension and a subsequent drop in cord perfusion. Owing to the rarity of SCI our unit does not advocate the routine use of spinal drains, unless the patient has significant risk factors for developing SCI. However, when spinal drains have been used in our institution, it has caused uncertainty amongst staff with regard to monitoring, management, documentation and instigation of interventions if a neurological deficit develops. In addition, no unified protocol was in place for routine monitoring of lower extremity vascular and neurologic status in patients undergoing TAAA. Following collaboration with vascular surgeons, interventional radiologists and intensive care we have developed an “Endovascular Repair Perioperative Care Plan” comprising protocols and care-bundles. Provision of this guide should allow for safe management of spinal drains and early detection of neurological deficit with prompt intervention to potentially reverse permanent paraplegia.

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Acute Kidney Injury(AKI) and Endovascular repair of aortic aneurysm(EVAR)- a retrospective review of practice at tertiary hospital

B Sridhar, Royal Stoke University Hospital

Contrast induced acute kidney injury (AKI) is an important complication that affects a significant number of patients and leads to adverse effects on prognosis and health care costs.(1). We investigated the incidence of AKI in post EVAR patients based on changes in creatinine value and estimated glomerular filtration rate (eGFR).

We reviewed electronic medical records of patients who underwent infra-renal EVAR for one year (January 2015 - December 2015). Risk stratification of patients was done using a cumulative risk score based on presence of individual risk factors.(2). We collected information about creatinine and eGFR values of our patients during pre-operative and post-operative phase (day 2, day 3 and 6 months after the EVAR procedure). The primary objective was to find out about the incidence of AKI as defined by Kidney Disease Improving Global Outcomes (KIDGO) clinical practice guideline for AKI and incidence of significant renal impairment which lasted beyond 6 months. The secondary objective was to find out about severity of AKI and also about the incidence of AKI defined by changes in eGFR.(2, 3).

A total of 54 patients underwent EVAR (10 females and 44 males, mean age was 78 ± 7 years). Among them 7 were emergencies and 47 were done as elective procedures. 10 patients (18.5%) developed AKI (stage 1: seven patients, stage 2: two patients and stage 3: one patient) as defined by changes in creatinine values whereas 14 patients (24.1%) developed AKI based on changes in eGFR. Four patients who had AKI according to KIDGO definition went on to develop long term change in kidney function whereas long term renal impairment was noted only in two patients who had AKI defined by changes in eGFR .

We conclude that the incidence of patients who developed AKI (based on creatinine values) after EVAR at our centre is similar to the quoted numbers in various studies. We also found that the incidence of AKI based on eGFR value was higher compared to AKI defined by change in creatinine value (24.1% vs 18.5% but this did not reflect into their likelihood to develop long term renal impairment. This might imply acute changes in creatinine had better ability to predict likelihood of long term renal impairment than acute changes in eGFR. Incidence of patients with long term impact on kidney function who had AKI (KIDGO criteria) was relatively high (4 out of 10 patients). This shows contrast has acute and long term detrimental effect on renal function of our patients undergoing infra renal EVAR. We should look into measures to decrease the incidence and thus providing better care to our patients and limiting our healthcare costs.

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Cardiopulmonary exercise testing (CPET) prior to abdominal aortic aneurysm (AAA) surgery: local audit and impact assessment

Alice Ward, Russells Hall Hospital

Cardiopulmonary exercise testing (CPET) is the most reliable and objective test for evaluation of fitness prior to elective abdominal aortic aneurysm (AAA) surgery. The Black Country Vascular Hub (BCVH) performs approximately 120 AAA procedures per annum and acquired CPET two years ago. The purpose of this service evaluation was to investigate if routine CPET testing has made any difference to the outcome for patients having AAA surgery.

Data was prospectively collected for AAA patients attending the BCVH pre-assessment clinic. Clinics are run by Consultant Vascular Anaesthetists and include CPET, quantification of risk and pre-optimisation. Outcome data was sourced from the National Vascular Database for both pre-CPET introduction (November 2007 - May 2014) and post-CPET introduction (May 2014 - January 2016).

The dataset included 372 pre-CPET and 135 post-CPET patients. The median age was 75 years overall. The open:EVAR ratio was 1:2.8 pre-CPET and 1:2.3 post-CPET. The median CPET to surgery time was 35 days. 14.7% of CPET patients did not receive surgery for their AAA. There were 2 deaths in the pre-CPET cohort, and 1 post-CPET. Since introducing CPET, mean length of stay (LOS) for open surgery has reduced by 2.3 days and EVAR surgery by 1.6 days (open $p=0.33$; EVAR $p=0.26$).

With no other practice changes in this time, the introduction of CPET has coincided with an increase in the proportion of open AAA repairs and an overall reduction in LOS. Although LOS results were not statistically significant, sample numbers were limited and the trend is towards significance. This CPET data show our EVAR patients are significantly less fit and more elderly.

This data supports that risk stratification in our Hub is functioning well and may ultimately yield a significant reduction in LOS.

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Patient positioning during regional carotid endarterectomy using the Oxford HELP pillow

Dr Lee Beale, University Hospital of Wales

Carotid endarterectomy (CEA) is a common vascular procedure with over 5000 cases performed each year in the UK [1] and routinely performed under regional or general anaesthesia. Our institution performs the majority of CEA under a regional technique, comprising of a superficial cervical block with intra-operative local anaesthetic supplementation. A common challenge encountered in our institution with a regional CEA is positioning of the patient in a position that offers good exposure to the neck and remains comfortable for the patient during the regional anaesthesia and surgery.

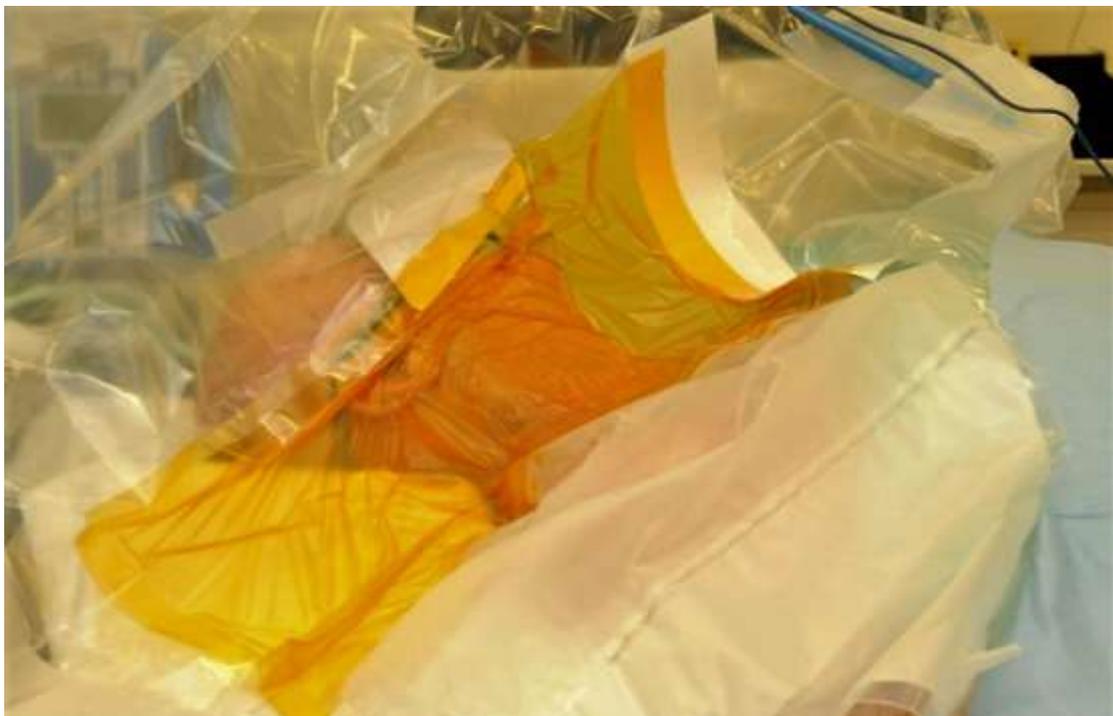
In order to perform a CEA safely, it is essential that the patient be positioned appropriately with the cervical spine extended and the head rotated to the opposite side, maximising the surgical exposure of the neck. Our previous practice involved the use of a pillow and head ring to achieve the desired position. This position offers a good surgical position but can often become uncomfortable for the patient. Should the need for airway intervention arise intra-operatively, manual handling of the patient is often required to re-position the patient which can compromise surgical site sterility.

To offer an improved patient experience while reducing manual handling requirements, our institution has introduced the Oxford Help Pillow as an adjuvant for the positioning of the patient. It is utilised from the start of the case to aid the regional block. It is safe and comfortable to transfer insitu into theatre with the patient positioned and without the need for further manual handling. The Oxford HELP Pillow can remain in place during the procedure, where it provides optimal surgical exposure of the neck (figure 1), and remains comfortable for the patient. Should the need for airway manipulation arise, minimal manual handling of the patient is required to achieve a safe position for oral tracheal intubation, while maintaining surgical site sterility.

This novel method of patient positioning using the widely available Oxford Help Pillow provides a safe, flexible and comfortable alternative to the traditional pillow and head ring for CEA surgery.

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Observation of current practice of the peri-operative care of lower limb amputation patients with a view to create a care pathway

Laith Malhas, University Hospitals Coventry and Warwickshire

Providing peri-operative care for patients requiring lower limb amputations due to vascular insufficiency presents a number of challenges to health care providers. This is due to the associated age and co-morbidities of these patients who often present extremely unwell. The challenge is also becoming more frequent due to increasing life expectancy and the diabetes pandemic. The outcome of these patients is often poor and good management requires comprehensive and structured multi disciplinary management. In order to improve mortality rates a Quality Improvement Framework (QIF) was published by The Vascular Society of Great Britain and Ireland (VSGBI) in 2010, which since was the focus of a NCEPOD report in 2014 which found implementation of the QIF was still poor.

Our aim was to observe and assess the current practice in a University Teaching Hospital using those relevant QIF points involving prompt management and anaesthetic care as a baseline in order to instigate measures to improve the service.

A retrospective sample for a 6 month period was identified through an electronic theatre system. The clinical and electronic records were reviewed and the relevant information extracted using an audit pro-forma then collated and analysed.

25 lower limb amputations were identified on 24 patients. Four were excluded for being traumatic in nature and one patient had a subsequent contralateral amputation within the same in-patient stay. 85% of the patients were male with a mean age of 71 and a mean BMI of 28 (with a bi-modal distribution). 95% were ASA grade 3 or above and multiple co-morbidities were identified. 85% were admitted to the renal or vascular wards with the most common admission diagnosis being cellulitis or ischaemia. 46% were reviewed within 24 hours from admission or referral by the vascular team, although this was over 48 hours in 33%. Vascular consultant review occurred within 48hr in 50% of patients. 42% of all patients received antibiotics within 6 hours and 100% of those with signs of infection did.

There was no evidence of a formal risk assessment in any patient although 30% were documented as "high risk". There was a delay of more than 48hr in 45% for time from the decision to operate to theatre, however the reasons were mostly due to patient consent issues. 57% were operated on in a dedicated vascular theatre with a consultant surgeon present in 71% and consultant anaesthetist in 76%. A variety of anaesthetic techniques and analgesia regimes were used with no obvious affect on

post operative course or pain issues. The acute pain team were only involved in 29%. Post operatively 53% were discharged within 30 days with the main delay for the remaining being rehabilitation placement availability. There was one in-patient death (occurring 10 days post operatively) giving a mortality rate of 5%, however the low number of patients in the study mean this is not generalisable.

Although many areas required improvement when compared to QIF targets, the main issues centred around general documentation of reviews and decision, with no patients having a documented formal risk assessment or anaesthetic involvement preoperatively. In light of this we have created a clinical pathway pro forma using the QIF to enforce the primary recommendation of the NCEPOD report. This includes therapeutic prompts and space for key information and is to be filed in the notes allowing for efficient reviews and future audits.

The management of lower limb amputation in a tertiary centre

Peter Paisley¹, Sally Jeffrey², I Raju³, Specialist Trainee, Glasgow Royal Infirmary¹, Specialist Trainee, Queen Elizabeth University Hospital, Glasgow², Consultant Anaesthetist, Queen Elizabeth University Hospital, Glasgow³

Introduction

The 2014 CEPOD report “Lower Limb Amputation: working together” is an extensive report on the management of patients undergoing lower limb amputation in the UK¹. It formed a critical review of how these patients are managed and highlighted a vast number of areas where clinical care or organisational issues could be improved. We sought to investigate how the treatment of patients undergoing non-traumatic lower limb amputation in our hospital (one of the largest vascular centres in the country) compared to the standards and guidance outlined in the CEPOD document.

Methods

Every sequential non-traumatic lower limb amputation conducted over a four month period was recorded. In line with the report, our aim was to investigate vascular amputations, thus amputations following trauma were excluded. We also excluded comparatively “minor” amputations such as digits or forefoot. Over the four month period, a total of 45 patients were included for analysis. We recorded data on patient demographics, pre-operative analgesia, intra-operative technique including use of adjuncts and postoperative length of stay.

Results

Our population ranged from the fifth to ninth decade, with the majority of patients (20; 44%) aged between 60-69. Twenty-six (58%) were male and 19 (42%) were female. Pre-operatively nine patients (20%) were not on opioids, 12 (27%) were on weak opioids, 18(40%) were on strong opioids, with a final six (13%) on high dose strong opioids. Thirty (76%) of our patients had a general anaesthetic compared to 61% nationally. Ten (22%) had a spinal anaesthetic compared to 38% nationally. A regional technique was employed in 71% of our patients which included femoral (7;16%), sciatic (18;40%), both femoral and sciatic (4,9%) and popliteal nerve blocks (2;4%). Our thirty day mortality was slightly higher than the national average (13.3% Vs 12.4%). Our mean length of stay was 37.8 days (range 4-121 days) which compares to national standards whereby 95% of patients were home by this stage.

Conclusion

We gathered a significant amount of data regarding the management of below and above knee amputations in our hospital. We found that our demographic was similar to that seen nationally. More of our population were taking strong opioids and less were on no form of opioid analgesic. More of our patients had surgery performed under general anaesthetic than the national average. Our length of stay and mortality figures were similar to other major vascular centres. Our aim is to use our data to address any areas where we differed from national standards and guidance by producing a local policy for how to best manage these patients pre-, peri-, and postoperatively regardless of whether they are carried out on vascular or emergency theatre operating lists.

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An audit of perioperative management of diabetic patients undergoing non-emergency vascular surgery

Sarah Sullivan, Queen Elizabeth University Hospital, Glasgow

Diabetes is increasingly prevalent: 10-15% of surgical patients have diabetes: vascular surgery is no exception. Management of diabetic patients undergoing non-emergency vascular surgery in our hospital was compared to standards based upon AAGBI guidance: "Perioperative management of diabetes in the surgical patient".(1) Our methods involved conducting a survey of our hospital's vascular anaesthetists. We then audited the perioperative management of diabetic patients undergoing non-emergency vascular surgery, which we defined as elective aneurysm repair, carotid endarterectomy (CEA), bypass grafting or vascular stenting.

Our survey of 8 vascular anaesthetists, asked:

1. Whether they would cancel a patient if the HbA1C was >75(mmol/ml)
 - a. Two stated "yes"
 - b. Six stated "no"
2. At what value of HbA1c would you cancel?
 - a. Six said that this would depend on the urgency of surgery and how realistic it would be to optimise HbA1c.
3. If a patient had an elevated CBG on the morning of surgery, would they cancel?
 - a. Two stated "yes" if ketonuria present
 - b. Six said that they would control with VRII
4. All anaesthetists stated that factors influencing decision making:
 - a. Need to proceed with surgery urgently such as CEA within 2 weeks
 - b. Tissue loss and sepsis would make optimisation impossible
 - c. Two stated "chronic poor control despite endocrine input"

Diabetic patients undergoing non-emergency vascular surgery were identified between 01/04/2016 - 01/05/2016. Compliance with the following standards was assessed:

1. HbA1c checked in past three months
2. HbA1c value
3. If the HbA1c value was over 69 was patient cancelled?
4. Did patients have U&Es and ECG carried out preoperatively?
5. Was capillary blood glucose (CBG) measured intra-operatively?

6. Was surgery for diabetic patients carried out first on the list?
7. Had known diabetic patients had endocrine input in past three months?

We analysed thirty patients. Of these, 11(37%) were diabetic. Of the 11 diabetic patients, 7(63%) had had HbA1c checked in the past 3 months. Mean HbA1c was 67, with a range of 44 to 85. All surgery proceeded despite HbA1c. 100% of patients had preoperative ECG and U&Es checked. Eight (72%) diabetic patients had a CBG checked intra-operatively with a mean result of 7.4. Three (27%) patients had no CBG recorded. Four (36%) of diabetic patients were listed first. Four (36%) had had endocrine input in the past 3 months.

These results indicate higher than population average incidence of diabetes. HbA1c was not checked in all patients, and even when high, surgery was not cancelled. This may be due to the necessity to proceed with surgery in a limited time frame. Most diabetic patients were not first on the list, despite being vulnerable to consequences of prolonged fasting. Only 36% of patients had secondary care endocrine review within 3months.

In conclusion, these results indicate that diabetes is a significant co-morbidity in our patients. In order to reach definitive conclusions, further data will be required; however it is clear that there scope to improve the perioperative management of our diabetic patients to prevent peri and post-operative morbidity and mortality.

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Intra-operative Blood Loss During Complex Endovascular Aneurysm Repair

Alistair Burns, Birmingham Heartlands

Endovascular aneurysm repair (EVAR) is an increasingly prevalent technique for the treatment of aortic aneurysms. Typical operative blood loss for elective infra-renal EVARs is quoted to be approximately 200ml; hence blood product replacement is rarely necessitated[1]. As the technique has evolved it has been employed for increasingly challenging cases. The term complex EVAR encompasses thoracic, fenestrated or branched repairs; these may be associated with additional vascular access points and increased operative time[2]. Absorbent drapes and swabs placed at port sites can make blood loss difficult to assess. Our aim was to evaluate intra-operative losses and transfusion requirements for patients undergoing complex EVARs in our trust.

Patients were retrospectively identified using the electronic theatre database for a 6-month period (01/12/15-31/05/16). All procedures recorded as endovascular were manually reviewed and categorised based on the surgeon's operative record. Pre and postoperative haemoglobin (Hb) levels were collated from the electronic results reporting system in addition to blood bank records of packed red blood cell (PRBC) administration. Post-operative Hb was recorded for post-operative days 1 and 2. The perioperative Hb drop was estimated using the maximal difference between pre and postoperative figures. Where blood products were administered during this time, each PRBC unit was equated to 10g/L.

85 EVARs were performed during the evaluated period with 57 cases categorised as elective complex EVARs. Two cases were excluded from analysis, as data was absent for pre or postoperative Hb level. Of the 55 cases evaluated the mean drop in Hb was 34g/L (range 6-94) with 20% of patients requiring transfusion of donor PRBCs either intra-operatively or within 3 days postoperatively. This figure rose to 29% over the full course of admission. Patients undergoing a complex EVAR received an average of 0.6 units PRBCs by day 3 postoperatively and 1 unit during the inpatient episode. Cell salvage techniques were not employed in any case evaluated.

While the authors acknowledge that an Hb drop is an imperfect method for estimating blood loss, the findings suggest that complex EVARs are associated with significant bleeding. Transfusion data supports this in identifying that 1:5 patients received blood products within 3 days postoperatively. Modifications in practice may be able to reduce the requirement for allogenic blood product administration with potential patient and cost benefits. Cell salvage provides a means of autologous

red cell replacement for complex EVARs. Non-absorbent drapes with collection pouches may be employed in conjunction with careful swab washing to optimise collection. Consumable costs at our trust are comparably low with collection being £16 per case, plus a further £50 where blood is prepared for reinfusion. In contrast a single unit of donor PRBC costs £120[3] with potentially associated costs of prolonged critical care admission and patient morbidity.

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Adherence to an enhanced recovery protocol (ERP) for patients undergoing endovascular aneurysm repair (EVAR)

Gemma Nickols, Southmead Hospital, North Bristol NHS Trust

This audit was conducted at North Bristol NHS trust, a major arterial centre where 60-70 elective EVAR procedures are undertaken per annum. The enhanced recovery protocol was first implemented in January 2015 and consists of pre-operative consultation with a clinical nurse specialist, anaesthesia and surgery guided by enhanced recovery principals and a dedicated post-operative care plan including specific daily goals^{1,2}. Conventional EVAR procedures have an expected length of stay of two days and more complex fenestrated or thoracic EVAR procedures typically have a five-day inpatient stay.

Data was collected from medical notes and hospital information systems for 3 months from June to September 2015. We included details of medical comorbidities, vascular-POSSUM scores and details of pre-operative optimisation plans. A record was kept of achievement of post-operative goals in addition to post-operative length of stay.

In total, 22 enhanced recovery records were analysed of which 20 patients underwent a standard EVAR and 2 patients underwent a fenestrated EVAR. Details of the baseline demographics and results are displayed in table 1. Cardiopulmonary pulmonary exercise testing (CPET) was used to assist with pre-operative planning and was performed in 11 cases (50%), with a mean anaerobic threshold recorded of 9.2. All patients received a general anaesthetic for the procedure. Four patients (18%) were initially cared for in a high dependency environment post-operatively and 18 patients (82%) returned to a vascular ward after the procedure. The standard EVAR group had a median length of stay of 2 days (mean 2.3) which is comparable to national standards³. Documentation in the postoperative care plan of ERP goals was low, with approximately half of the data points not recorded. Of the patients who had their post-operative goals recorded, 49% were achieved on the day of surgery, 60% on post-operative day 1 and 79% on post-operative day 2.

Adherence to many of the aspects of the ERP was excellent including use of carbohydrate drinks, breathing exercises and early commencement of enteral fluids and nutrition. Other aspects that were less likely to be fulfilled included early mobilisation and discharge planning. This audit also demonstrates that record keeping of post-operative goals within the care plan was frequently below the expected standard. We hypothesise that this may be in part due to the design and length of the booklet used in our trust.

The ERP care plan booklet which was in use since the ERP was adopted was phased out following this audit due to poor levels of compliance with completion of the documentation. The principals of enhanced recovery following EVAR were still maintained in all aspects of the care for these patients. A further audit of length of stay between February and April 2016 shows that length of stay has not increased (n=13, median 1 day, mean 2.0 days). This suggests that the principals of enhanced recovery care become embedded within an organisation over a relatively short period of time and remain despite fewer physical reminders for nursing and medical staff.

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Challenges faced in the preoperative management of a complex ruptured abdominal aortic aneurysm with an aorta-caval fistula

Dr. Reema Ayyash, James Cook University Hospital

Introduction

Aorta-caval fistula (ACF) is a rare complication of a ruptured abdominal aortic aneurysm (AAA). Clinical presentation may vary dependant on rupture and haemodynamic instability and may mimic cardiac conditions. Our case highlights important challenges.

Report

An 81-year-old hypertensive male presented with a day of severe abdominal pain and associated vomiting. He was diaphoretic and tachycardic. Abdominal exam revealed a large pulsatile mass. Baseline investigations showed relative hypotension (inter-arm deficit of 20mmHg), new ischaemic changes on ECG, acute kidney injury (AKI) and raised lactate.

CT angiogram confirmed a 90mm infrarenal AAA with ACF to lower inferior vena cava (IVC), Figure 1. The conical, angulated neck exceeded 'instructions for use' for endovascular stent repair (EVAR) but was considered the safest option for treatment given the high predicted mortality for open repair in this patient.

General anaesthesia (GA) was the preferred choice and induction was achieved with a cardiostable anaesthetic, following routine monitoring and arterial line insertion. Metaraminol infusion maintained a MAP >80. Surgery commenced immediately with prompt and successful deployment of a Gore® Excluder® stent graft. During cannulation of stent body for deployment of contralateral limb, progressive hypotension and cardiac instability were observed, with minimal response to adrenaline, magnesium and calcium chloride. Inotropic support was commenced. Stability was restored after deployment of contralateral limb. A type-1a endoleak was managed with an aortic extension stent. Postoperative metabolic acidosis and coagulopathy resolved in intensive care with no evidence of AKI or systemic inflammatory response. He was discharged home on day-4 and follow-up CT at 30-days showed type-II endoleak into IVC and 2cm reduction in aneurysm sac size.

Conclusion

Patient's typically present with shortness of breath, abdominal pain and pulsatile abdominal mass. Late presentations include high output cardiac failure and limb discoloration. Understanding of variable clinical presentation is imperative for prompt recognition to improve morbidity and mortality.

These cases pose a number of challenges. Appropriateness and type of surgical repair need consideration. Whilst there is sparse literature relating to success of EVAR, it offers an attractive alternative due to reduced physiological stress and minimal blood loss. A systematic review demonstrated a procedural success rate of 94% and 90-day mortality of 10% with EVAR. Some consider this treatment to be incomplete as it does not directly occlude the ACF.

Anaesthetic choice is governed by comorbid state and evidence of decompensated heart failure or haemodynamic instability. A randomised controlled trial reported EVAR under local anaesthesia is associated with reduced mortality, however GA maybe favourable owing to complexity of these cases.

Intraoperative management maybe complicated by presence of heart failure and avoidance of fluids is pertinent to avoid exacerbation. Significant instability in our case was noted after deployment of stent body and insertion of contralateral limb. This maybe due to a re-entry circuit through the fistula resulting in high peripheral resistance. Haemodynamic changes were completely reversed after ACF closure.

Our case highlights the importance of collaborative multidisciplinary discussion and emphasises that complex cases require specialty specific experienced practitioners

Audit of post-operative blood pressure management in carotid endarterectomy patients following introduction of a recovery guideline

Dr K Nickell, North Bristol NHS Trust

North Bristol NHS Trust performs approximately 125 carotid endarterectomy procedures per year, following centralisation of vascular services in the Bristol region [1]. The majority are managed post-operatively with an extended stay in recovery rather than in a high dependency unit. Acute post-operative changes in arterial blood pressure (both hypo- and hypertension) are common in this group of patients. It has been shown that poor blood pressure control is associated with increased mortality and morbidity, including haematoma necessitating return to theatre, cerebral hyperperfusion syndrome and myocardial ischaemia[2][3].

Given the importance of careful blood pressure control following carotid endarterectomy, a local guideline for post-operative management was developed and introduced in late 2014 (figure 1). The guideline sets out blood pressure parameters, guidance on how to manage out of range readings and contact details for appropriate anaesthetists and surgeons. We audited post-operative management of patients both before and after guideline introduction, collecting data on whether blood pressure targets were set for patients, the adequacy of blood pressure control, use of vasoactive agents and post-operative complications.

Of 31 consecutive cases in a 3 month period preceding introduction of the guideline, 22 sets of notes were available for review. Of those, 6 patients (27%) had no agreed blood pressure target range for the recovery period and 7 patients (32%) spent at least 30 minutes with blood pressure readings outside the ideal post-operative range (blood pressure target range if documented or +/-20% from baseline). One patient returned to theatre for evacuation of haematoma and was then admitted to intensive care.

Following introduction of the guideline, we gathered data from cases over a 6 month period. Of the 63 patients who underwent carotid endarterectomy during that period, 40 patients had data collected. The new guideline was used in 38 patients (95%) and an agreed blood pressure target range was documented for all 40 patients. 7 of the 40 patients had blood pressure readings outside their target

range for at least 30 minutes (18%). No patients had major complications or required intensive care admission.

We are in the process of surveying the recovery staff on the clarity, ease of use and usefulness of the guideline, which will guide further modification if necessary. However, this initial audit has shown an increase in the proportion of patients having a target blood pressure range documented from 73% to 100% following introduction of the guideline. There was also a decrease in the proportion of patients with blood pressures outside the target range and no major complications in the group of patients in whom the guideline was used. We conclude that introduction of a guideline for post-operative management of carotid endarterectomy patients improves both documentation of target blood pressures and blood pressure control in the recovery period.

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Th...	Anaesthetist Phone.....	Patient label
	Surgeon Phone.....	

CAROTID ENDARTERECTOMY RECOVERY GUIDELINE

Key handover points between anaesthetist and recovery

1. Documentation of pre-existing neurological deficit
2. Postoperative BP limits determined by anaesthetist and surgeon at WHO sign out
3. Functioning arterial pressure monitoring
4. Contact details of anaesthetist and surgeon for recovery support

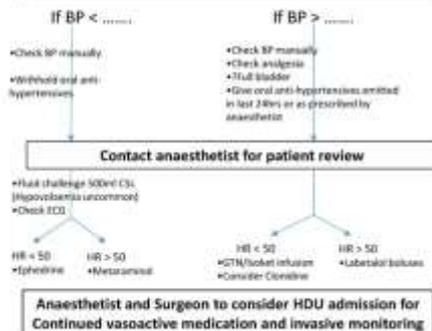
Minimum monitoring in Recovery

- Continuous arterial blood pressure monitoring
 - Heart rate, respiratory rate, oxygen saturation and temperature
 - Neurological observations every 15 mins for 3rd hour and then every 30 mins
 - Glasgow Coma Scale, including monitoring for sudden change in vision
 - Bilateral limb power (L/R) and sensation
 - Facial asymmetry
- Minimum 4 hrs in recovery if stable without administration of any vaso-active agents

Acute neurological change or haematoma is an urgent problem
Contact anaesthetist and vascular surgeon immediately

Lowest systolic BP Highest systolic BP

BP RANGE (mmHg)



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 November 2014

GUIDANCE ON SETTING BP LIMITS POST-OP

- Typical BP limit is Patient's baseline BP +/- 20%
- Anaesthetist doing case to document baseline BP (based on pre-op/intra-op readings)

Reduce maximum BP limit if:

- patient at risk of cerebral hypertensive syndrome
- poorly controlled hypertension
- CVA < 30 days
- contra-lateral carotid stenosis
- intra-operative thromb

Increase minimum BP limit if:

- patient at increased risk during hypotension
- severe coronary artery disease
- metallic prosthesis valve
- moderate/severe aortic stenosis
- renal artery stenosis
- contralateral carotid stenosis

GUIDANCE ON ADMINISTRATION OF VASOACTIVE AGENTS

- **Do not avoid Asp if unstable** with vaso-active agents, a precipitous change in BP can be disastrous.
- **Labetalol:** Titrable slow IV boluses - 10mg every 2 mins. Maximum 300mg in 20 mins

CEA HAEMATOMA GUIDELINE

- An expanding swelling or bleeding from the wound can compromise the airway
 - If more than 100ml in the drain in any one hour – call surgeon
 - Difficulty swallowing may be a sign of haematoma and impending airway compromise – seek urgent review
- 1) Sit patient up, apply high flow oxygen
 - 2) Check drain is open
 - 3) Apply pressure
 - 4) Contact vascular anaesthetist and surgeon
 - 5) Consider removal of wound sutures/clips

ACUTE POSTOPERATIVE NEUROLOGICAL CHANGE

Any change in neurological observations is an URGENT problem:

- 1) Contact vascular anaesthetist and surgeon immediately
- 2) Follow BP management procedure

Out of Hours Contact (if theatre B/vascular hybrid has finished)
3rd on Call Anaesthetist: 9034
On Call Anaesthetic Consultant: 9030
On Call Surgical Registrar 9772
Vascular Surgery Consultant: Mobile via Switch

All Patients after CEA must go to ward 33b

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An evaluation of using Thrombelastography® Platelet Mapping™ to monitor platelet inhibition by aspirin and clopidogrel

Aayushi Gupta, Medical Student, University College London

The main components of blood coagulation are plasma clotting factors, fibrinogen and platelets, with the latter responsible for 80% of clot strength (1). An increase in cardiovascular disease with thrombotic complications has led to more patients being prescribed antiplatelet medication such as aspirin and clopidogrel. These drugs elicit variable responses between individuals. Thrombelastography Platelet Mapping (TEG-PM) is a point-of-care test that quantifies how inhibited an individual's platelets are by medication. Low inhibition increases the risk of thrombotic events, whereas high inhibition leaves patients susceptible to bleeding. Stratification of inter-individual variability, using TEG-PM, could allow personalisation of therapy, potentially reducing the morbidity and mortality associated with perioperative bleeding or thrombosis.

The aim of this investigation was to assess the impact of percentage platelet receptor inhibition (PRI), measured by TEG-PM, in 3 treatment groups: dual antiplatelet therapy, aspirin-only and clopidogrel-only. The effects of PRI on units of packed red blood cells (PRBC) transfused, likelihood of procedure cancellation and frequency of post-operative complications were investigated.

Retrospective analysis of 145 patient records revealed percentage PRI did not correlate linearly with intraoperative units of PRBC transfused ($p=0.618$) or complications ($p=0.106$), however with the application of a threshold of 34% PRI, it was found 78.6% of transfusions and 82.0% of complications occurred above this value ($p<0.05$ and $p<0.005$, respectively). This threshold was determined from previous studies, which found that below 34%, patients were lower-risk for bleeding (2). In the clopidogrel-only group, patients with postponed procedures had significantly higher PRI than those who proceeded to surgery ($p < 0.005$) (figure. 1). Similar results were found across treatment groups, although not significant.

In this study, PRI was significantly related to bleeding and complications when a threshold of 34% was used as a cut-off. A large number of patients undergoing vascular surgery are on anti-platelet therapy, and our results may help in planning surgical procedures for such patients, allowing a better understanding of the risks of bleeding and thrombosis during the perioperative period. A prospective study in patients with peripheral vascular disease to look at this issue is currently underway at our institution.

Fluid warming in vascular surgery: Can the tendering process affect clinical practice?

Dr. Caroline Curry, Royal Victoria Hospital Belfast

Purchasing equipment is subject to regulations that often results in clinicians having to use a product that would not be their choice. The tendering process is difficult to navigate and often a small group make decisions on behalf of many. NICE recommendations are frequently used to guide the tendering process. The balance between economy and clinical performance is difficult but foisting equipment on reluctant users is never effective. NICE guidelines (1) recommend fluid warming as a routine strategy to prevent peri-operative hypothermia and a recent tendering process has changed the fluid warmer in our theatres from the Intersurgical Hotline to the 3M Ranger. The Ranger uses a hotplate to warm fluids both at low rates, and by the addition of an electrically powered pneumatic chamber, at rapid infusion rates. The Hotline is a coaxial tubing with an outer heated saline chamber warming the inner chamber containing intravenous fluids. Previous studies (2) (3) have compared the performance of the fluid warmers at high flow rates or under pressure but it was our hypothesis that one fluid warmer would not perform consistently over a range of flow rates.

Prior to our study we performed an audit of our routine fluid administration rates in theatre. We looked at 100 consecutive patients from 14 theatres, including two vascular, and found an average administration rate of 506ml/hr for a range of surgical specialties and operative times. Based on these results we designed an experiment to compare the performance of the Hotline and the Ranger over a range of fluid administration rates. We used a 44ml Ranger giving set and a 20ml Hotline giving set and measured the temperature at the end of these to represent the insertion point of an intravenous cannula. A three way tap was added at this point for ease of sampling. A series of Baxter Flo-Gard 6201 infusion pumps was set up to administer room temperature 0.9% saline from 100ml/hr to 6000ml/hr. The fluid rate was increased in 100ml/hr increments and after enough time had elapsed to clear the dead space the temperature was measured. The fluid was diverted via the 3 way tap into the barrel of a 5ml syringe and the temperature of the inflowing fluid was recorded with a calibrated temperature probe.

Our results showed that the 3M Ranger is ineffective at the low flow rates we use for routine fluid administration. At 500ml/hr fluid at the sampling end was at 28.5 degrees Celcius compared with 41 degrees Celcius with the Hotline. The Rangers performance improved as flow rate increased but it required flow rates of 3700ml/hr or more before it outperformed the Hotline. This rate is far in excess of that required the majority of vascular operations.

Whether or not you agree with the NICE guidelines or believe that IV fluids are an effective means of preventing hypothermia the tendering process has left us paying for a product which does not perform effectively under our normal working conditions.

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Delayed presentation of critical upper limb ischaemia following brachial arterial line placement in a grandmultiparous lady

Jenna Stevens, Royal Gwent Hospital

We report the case of a 41 year old lady presenting with a critically ischaemic right upper limb after brachial arterial line placement following complications during the delivery of her sixth child. Our patient spoke minimal English, had a raised BMI, and an obstetric history of preeclampsia and gestational diabetes. She had an examination under anaesthesia (epidural top-up) for removal of retained placenta following a spontaneous vaginal delivery, suffering a 3000ml blood loss. Peri-operatively, she had a short period of hypotension, requiring peripheral vasoconstriction and cautious fluid resuscitation (preeclampsia). In view of the above factors, a decision to site an arterial line was made. After two failed attempts at siting a radial artery cannula, a brachial artery cannula was placed under ultrasound guidance. The cannula was removed uneventfully 20 hours after insertion.

Ten days later, she presented with a three day history of pain and reduced sensation in her right hand and forearm. Critical limb ischaemia was diagnosed. She required three vascular surgical interventions to restore circulation. The surgery was difficult and complicated by repeated episodes of intra-operative vasospasm. Currently, she has normal sensation, but reduced motor function of her hand and is requiring ongoing physiotherapy.

Arterial line cannulation is frequently used to provide easy access for continuous and real-time systemic blood pressure measurements, blood gas analysis and other laboratory measurements [1] and is required for close monitoring of obstetric patients with severe preeclampsia. Studies have shown that the overall incidence of complications following arterial line placement is very low, but female sex is a risk factor for complications [2]. The brachial artery may be associated with increased thrombotic complications in view of the lack of collateral circulation [3], however, a study by Bazarl et al [4] did not demonstrate any adverse events in over 3000 brachial artery cannulations. A systematic review of 23 studies by Hausvater et al in 2012 showed significant increase in arterial stiffness measurements in women with preeclampsia [5].

Our patient had a number of risk factors for development of an arterial line complication. We hypothesise that the combination of preeclampsia, hypotension and a hyper-coagulable state contributed to her risk.

As a result of this case, we have identified gaps in our documentation of both successful and failed arterial line insertions. We have initiated a quality improvement project to improve documentation of arterial line insertions within our department. A sticker has been developed to document the indications for insertion, number of attempts, equipment used and technique employed.

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Building in Safety & Design for the new 'Hybrid' Theatre Era – Beyond the 'Nuts & Bolts' (a qualitative analysis)

Dr Aynkaran Dharmarajah, Northwick Park Hospital

As one of six regional vascular referral units in London, our centre built a new state of the art 'hybrid' vascular operating suite to facilitate the ever-increasing workload & complexity required for endovascular work.

There is no published data on how to design & build a safe new 'hybrid' theatre suite. The concept of safety also extends beyond the environment to the multi-disciplinary teams that integrate to perform complex vascular procedures.

Following two 'Never events' in two consecutive years, this was a critical opportunity to build in safety through theatre design, & implement a 'Standard Operating Policy' for smooth transition to the new 'Hybrid theatre suite' for all patients & team members. Errors in healthcare result in part from poorly designed complex systems [1].

Building in safety for theatres started with stakeholder meetings involving the building project manager, general managers, Consultant vascular surgeons, Consultants in Interventional radiology, Consultant anaesthetists, vascular theatre nurses, & radiology nurses.

There were multiple steps in the process that required team working & brain storming together; 'needs & budget analysis,' evaluation of hardware & equipment, site visits, and review of proposed plans/drawings.

Designs were further enhanced by process mapping usage within teams, thereby improving safety & ergonomics for all users by reducing the number of steps in any given process, adopted from Six Sigma [2].

When the concrete shell of the building was built, shortlisted designs were evaluated & modified using 'mock-ups' of the anaesthetic room & operating theatre. E.g. screen position changed for light source.

The final design was taken forward to the build stage. On completion, multi-disciplinary simulations identified safety & ergonomic specification changes required before going 'live.' E.g. High visibility 'red box' for emergency anaesthetic drugs & equipment.

In addition, equipment training was provided to aid safe operation in theatres.

During the team working process, it became apparent conduct within theatres could be improved. Therefore, stakeholder meetings were set-up to create a 'Standard Operating Protocol.' The main features were to define roles & responsibilities, adopt a vascular specific WHO checklist, standardise processes for running the 'Hybrid theatre,' and enhance 'theatre' etiquette.

The sum of all these component changes resulted in a safe transition to the new theatre environment & new theatre teams. There have been no further 'Never Events' since opening the 'Hybrid' suite two years ago.

Qualitative thematic analysis of staff surveys showed improved perception of safety, working environment, & ergonomics. A comment from survey highlighted building the 'hybrid' suite has progressed interventional techniques, allowing anaesthetic technique to change towards

awake/sedated patients, which we assume benefits this high-risk population.

Finally our 'standard operating policy' was commended by the Royal College of Surgeons. We hope this model shows the value of an iterative end user process, & acts as a useful resource for others embarking on a similarly exciting venture.

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Post-operative analgesia following lower limb amputation – An audit of current practice at a tertiary vascular centre

Dr Katie Ayyash, York Teaching Hospitals NHS Foundation Trust

Introduction

Pain following lower limb amputation (LLA) can contribute to long-term physical and psychological morbidity. Management of acute postoperative stump pain is imperative to lessen development of chronic pain and phantom limb pain [1,2]. Following the introduction of sciatic nerve catheters (SNC) in our institution, we undertook a clinical audit of our current practice with 3 specific aims:

1. Evaluate effectiveness of current SNC ON-Q* Fixed Flow Pump by HAYLARD
2. Assess the impact of SNC infusion on subjective pain scores
3. Evaluate involvement of pain team postoperatively

Methods

A retrospective case note review of all patients who underwent LLA over a 6-month period in 2015. Modalities of pre-, peri- and postoperative analgesia with subsequent pain scores were evaluated on days 0, 1 and 2.

Results

44 patients were identified - 28 had undergone a below knee amputation (BKA), 14 Above Knee Amputation (AKA) and 1 through knee amputation. Results with respect to aims above are described below:

- a) Assessment of pain - 16% of cases received incomplete assessment of postoperative pain
- b) Preoperative analgesia - 93% received simple analgesics in addition to a GABAergic and/or an opioid adjunct
- c) Perioperative analgesia - 31 patients received a SNC. Table 1 depicts the mean pain scores in this patient group compared to no SNC. The mean pain score over 72hrs postoperatively with an additional LA bolus at time of catheter insertion was 2.58 in BKA compared to 3.83 in AKA. Postoperative pain scores were not affected in patients who received SNC ON-Q* Pump volumes 270ml, 400ml or 500ml with fixed flow rates of 5ml/hr or 8ml/hr
- d) Postoperative analgesia – In addition to simple analgesics, 41% required additional opioid analgesics while 1 received ketamine
- e) Pain team review – 11 patients with pain scores averaging 4.6 and 5.3 on days 1 and 2 postoperatively were reviewed. Of these, 8 patients were prescribed additional opioids and 1 patient was referred to the chronic pain team

Recommendations

This audit has highlighted:

1. Inconsistent use of SNC with or without administration of an LA bolus at time of catheter insertion despite evidence suggesting patients with a sciatic nerve infusion were marginally more comfortable overall.
2. SNC ON-Q* Fixed Flow pain relief systems are generally not effective in providing continuous pain relief as demonstrated by the consistently higher pain scores particularly in the later days postoperatively. Possible reasons include: catheter displacement, flow controller not taped to skin thus

delaying delivery of LA, and inability to administer an additional LA bolus on the ward.

3. Newer ON-Q* pain relief systems with “select-a-flow” and “on-demand bolus” may help to overcome many of these difficulties. A postoperative pain guideline for LLA is in development to standardise use of a SNC with an LA bolus unless contraindicated.

4. We advocate all patients with a peripheral nerve catheter should be reviewed by the pain team postoperatively.

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An audit looking at adherence to safe radiation exposure levels to Anaesthetists during Endovascular Aortic Repairs in a new Hybrid Theatre

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Radiation effects are well publicised and safe limits are set by the International Commission of Radiological Protection (ICRP). The installation of Hybrid theatres has resulted in procedures such as endovascular aortic repairs (EVARs), yet have led to potential increases in occupational radiation exposure.

During an EVAR patients are required to breath hold. This improves image quality for Digital Subtraction Angiography (DSA) acquisitions performed at 4 frames per second (fps). During this period the anaesthetist is often at the patient’s head placing themselves close to the x-ray tube. The production of scatter radiation as a result of x-rays hitting a patient is the main source of radiation to staff (1).

In 2015 an audit was carried out that looked at the radiation exposure to anaesthetists during infra-renal EVARs that were carried out in the Hybrid suite at The Royal Oldham Hospital (TROH). The aim of the audit was to find out if the cumulative radiation level that anaesthetists were exposed to fell within the accepted ICRP range.

In 2015 between July and August dosimeter badges were provided for anaesthetists to wear on their forehead to monitor eye exposure and under the lead gowns to measure total body exposure. One set of badges were to be worn by all anaesthetists which would provide a cumulative dose for all. The wearing of the badges was not, however, enforced.

From September to October the dosimeter badges were worn for all EVARs. The value recorded by the badges of absorbed radiation was measured in Sieverts (Sv). The dosimeter worn underneath the lead gown is used as a surrogate for total body effective dose Hp(10) and the eye badge as a measure for equivalent dose to the lens of the eye Hp(3)(2).

The cumulative doses from each 2 months were then looked at and compared each other and against ICRP dose limits. The current limits are shown below.

During July and August 16 infra-renal EVARs were carried out. The total effective dose was measured as 0 mSv, however, the equivalent dose was recorded as being 0.23 mSv. Over a year this would cumulate to an exposure dose of 1.38 mSv which is still well within the recommended dose limit.

In September to October only 7 EVARs were done. The badges were, however, fully worn and when evaluated showed both Hp(10) and Hp(3) to be 0.0 mSv, showing a drop in eye exposure to radiation. From the data gathered it can be concluded that currently there is no concern about the level of radiation exposure at TROH. The dosimeters detected no radiation on both badges.

There were limitations to the audit. The radiology department made changes during the 1st audit period and were as follows:

- 1.Reducing from 4 fps to 2 fps
- 2.Change from magnification to digital zoom
- 3.Changes to radiation protocols

This led to overall reduction in the radiation dose used by the time the second set of dosimeter badges were used. This will impact the results by causing reduced exposure.

References

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Peri-operative hypotension in patients presenting with ruptured abdominal aortic aneurysms

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The mortality from ruptured abdominal aortic aneurysm (AAA) remains high at 37% for open repair and to 25% for endovascular repair (EVAR). (1) Sub-analysis of the recent IMPROVE trial suggested that low systolic blood pressure was associated with higher mortality rates. (2) This study aims to highlight current anaesthetic practice in our specialist vascular centre in Southmead Hospital, focussing on initial management including blood pressure and fluid resuscitation, and assess whether low blood pressure is associated with higher mortality in our centre.

Methods

We performed a retrospective analysis including all patients presenting to our vascular centre with ruptured abdominal aortic aneurysm over a 2 year period. Patients were identified using the National Vascular Registry, and data collected from case notes, imaging and investigations. Seventy three patients were identified. We aimed to assess the resuscitation of patients who present with ruptured AAA, including pre-operative and intra-operative lowest systolic blood pressure and surgical approach. The primary outcome was 30-day mortality.

Results

Overall 30-day mortality was 31% (23 of 76 patients).

In this patient cohort, hypotension both pre-operatively and intra-operatively, was common. Pre-operatively, 50.7% (37 of 73 patients) had a systolic blood pressure (SBP) <100 mmHg, and 15% (11 of 73 patients) with SBP <75 mmHg. It is unclear whether these results reflect haemodynamic instability or an active choice to maintain low SBP. However, intra-operative hypotension featured in the majority, with SBP <100 mmHg in 76.7%, and SBP <75 mmHg in 20.5%.

This study supports recent findings that permissive hypotension, specifically with SBP <75 mmHg, is associated with higher mortality. (2) These findings may have consequences for the choice of resuscitation strategy on presentation. We found that patients with pre-operative SBP <100 mmHg had a mortality rate almost double that of patients with SBP >100 mmHg (35.1% versus 19.2%, respectively). Intra-operative SBP was inversely proportional to mortality - 30-day mortality was 66.7% in those with intra-operative SBP <75 mmHg, 35.7% in those with SBP <100 mmHg, and none of the 14 patients with SBP >100 mmHg intra-operatively were deceased at 30 days.

Conclusion

We have observed increased mortality rates in patients with low pre-operative and intra-operative SBPs. Further work with a greater sample size is required to confirm any correlation between permissive hypotension and mortality; and to establish if this patient group would benefit from the introduction of a goal-directed resuscitation bundle.

References

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2. IMPROVE trial investigators. Observations from the IMPROVE trial concerning the clinical care of patients with ruptured abdominal aortic aneurysm. *Br J Surg*. 2014;101:216-24

Nickel allergy in EVAR: Survey of current practice and literature review

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Introduction: A patient presented with a 6cm infra-renal abdominal aortic aneurysm, detected upon screening, for EVAR. At the safety brief it was highlighted that he had a significant allergy to nickel which had previously required hospital admission. Nitinol EVAR stents contain nickel, their use in nickel allergy contraindicated by the manufacturer. The procedure was postponed and the patient returned for an open repair at a later date. **Background:** Nickel allergy is common with prevalence in Europe of 5-17% in women and 0.5-3% in men(1), effecting type 4 hypersensitivity resulting in allergic contact dermatitis (ACD)(2). Sensitisation is by skin contact with a high concentration of sweat soluble nickel (3). Systemic elicitation of allergic contact dermatitis is well documented for a small proportion of nickel sensitised patients, however controversy exists regarding sensitisation when nickel is taken intravascularly(4). ACD is diagnosed with allergen patch testing. Endovascular grafts used in EVAR contain Nitinol, a self-expanding support structure composed of 50-55% nickel and 21% titanium. A literature review has revealed only anecdotal evidence in the form of case reports with adverse events pertaining to allergy which may have been related to any component of the endografts used in EVAR.

Methods: A survey was emailed to all consultant radiologists and vascular surgeons in Scotland who undertake EVAR to explore how a similar case would be managed within their units. **Results:** Responses were limited. 5 consultant interventional radiologists and 2 consultant vascular surgeons responded, of which four would have offered an alternative to EVAR, one would test for nickel allergy prior to proceeding and one would proceed with EVAR, with one non responder. None of the seven respondents would have tested for nickel allergy. Two respondents were aware of an alternative endograft that does not contain nickel, i.e. the Cook Zenith (see discussion). None of the seven respondents, none had experienced complications due to suspected nickel allergy following insertion of EVAR endograft, or indeed any sort of endograft. **Discussion:** Responses were limited but demonstrated variation in practice. Literature review on nickel containing cardiac devices: 67 patients, who underwent interventional ASD closure with Nitinol devices, a significant rise in serum nickel concentration, peaking at one month, although highest levels measured were still within normal limits. A study of 131 patients with 171 stents 6 months after implantation found that patients with positive patch-test to nickel and molybdenum had a higher frequency of stent restenoses than patients without hypersensitivity(5). However, in another study 149 patients undergoing balloon angioplasty were tested for nickel allergy prior to undergoing stent insertion. 14% of all patients in the study suffered stent restenosis, but of the group testing positive for nickel allergy, only 12% developed restenosis(6), suggesting that there was no increased risk. Grafts composed of Nitinol (e.g. Gore Excluder, Medtronic Endurant, Cook LP, Vascutek Anaconda) have larger quantities of nickel than stainless steel grafts (Cook Zenith Flex). All manufacturers recommend that their grafts should not be inserted in patients with allergies to any of their components. **Conclusion:** No evidence base specific to EVAR, current practice varies, studies from cardiac devices suggest unlikely to result in harm.