



**Summer Scientific Meeting of the
Anaesthetic Research Society**

Liverpool Medical Institution
114 Mount Pleasant, Liverpool, L3 5SR

June 30th & July 1st 2011

All presentations at this meeting of the ARS will be verbal and will be allocated 16 minutes for presentation and discussion. Of the 16 minutes allocated, 8 minutes is the maximum usually allowed for presentation. The session chairman will determine the transition between presentation and discussion and between papers.

Endogenous heparin-like substances and their effect on thromboelastography (TEG) and postoperative graft function following orthotopic liver transplantation (OLT)

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Liver transplantation is associated with severe coagulopathy especially after graft reperfusion. TEG is routinely used to monitor clotting and guide product transfusion. Previous small studies have reported a heparin-like effect seen on postreperfusion TEG.^{1,2} This effect may be due in part to release of glycosaminoglycans (GAGs) by vascular endothelium. Endothelial cells are known to produce heparan sulphate and also bind other heparin-like substances for example dermatan and chondroitin sulphate.³ This heparin effect may also be caused by exogenous administration of heparin to the donor liver prior to transplantation.

The aims of this project were to audit blood product use (whether they were being transfused in accordance with our TEG-based guideline), and to investigate whether a heparin-like effect was apparent in our patients. We further sought to determine its relationship with postoperative graft function.

We performed TEG without clot activator after induction of anaesthesia, before and after graft reperfusion as part of clinical routine in 364 patients. Samples were analysed in 'native' and 'heparinase treated' cuvettes. Data are expressed as mean \pm SD.

Our use of FFP significantly correlated with TEG variables r , k and α ($p < 0.0001$, $r^2 = 0.37$). However, platelet and cryoprecipitate transfusion did not appear to be guided by TEG. A positive heparinoid effect was seen in 90.0% of patients. The coagulation time [$r + k$] was 52.0 ± 28.0 mins (native) vs 35.2 ± 17.7 mins (heparinase treated). The mean ratio was 1.84 ± 1.22 . In a multiple linear regression model postoperative liver function (ALT) was significantly correlated with "heparinoid effect" (assessed by native/heparinase treated [$r + k$] ratio), with age, gender and diagnostic category, $p = 0.04$. However the heparinoid effect did not correlate with hard outcome measures.

We have shown that although the use of FFP appeared to be rational, transfusion of platelets and cryoprecipitate did not appear to be guided by TEG. A clinically relevant heparin effect exists following liver reperfusion in OLT in 90% of patients. This effect is related to postoperative liver function. The explanation for this observation requires further investigation but does not appear to presage worse overall outcome.

References: (1) Hardings SA, Mallett SV, Peachey TD, Cox DJ. *BJA* 1997;78:175-179; (2) Kettner SC, Gonano C, Seebach F, Sitzwohl C, Acimovic S, Stark J *et al.* *Anesth Analg* 1998;86:691-5; (3) Bourin MC, Lindahl U. Glycosaminoglycans and the regulation of blood coagulation. *Biochem J* 1993;289:313-30

Adiponectin expression in skeletal muscle and its response to LPS treatment

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Adipose tissue is an endocrine organ which produces signalling proteins involved in inflammation and glucose homeostasis¹. One of these proteins, adiponectin, promotes glucose utilisation and fatty acid oxidation. Adiponectin has previously been thought to be an adipose specific molecule, however recent evidence suggests expression in skeletal and cardiac muscle, and endometrial tissues²⁻⁵. In this study, we investigated skeletal muscle adiponectin expression levels and the effect of LPS treatment.

25 mg/kg lipopolysaccharide (LPS) (*Escherichia coli* O 111:B4) was injected intra-peritoneally (ip) under general anaesthesia into 8-10-week-old male C57BL/6J mice (Charles River, UK) Control animals received equivalent volumes of normal saline. Mice were killed at 4 or 24 h. Soleus muscle depots were removed and immediately frozen in liquid nitrogen. mRNA levels were determined by PCR. RT-PCR was performed in a 12.5 µl reaction volume consisting of 12.5 ng of reverse transcribed cDNA mixed with optimal concentrations of primers and probe and qPCR™Core kit (Eurogentec, UK) using a Mx3005P detector. Sequencing of PCR product was performed using the Nucleospin PCR clean-up gel extraction. Statistical significance was determined using Mann–Whitney U tests. The threshold for significance was $p < 0.05$.

RT-PCR indicated that the adiponectin gene is expressed in skeletal muscle (adipose tissue was used as a positive control), and sequencing of the PCR product confirmed a 100% match for adiponectin mRNA. C2C12 myocytes were then used to verify the presence of adiponectin mRNA in skeletal muscle cells. Adiponectin mRNA level was reduced in skeletal muscle in mice following ip injection of LPS by 6.9-fold ($p < 0.05$) and 30-fold ($p < 0.001$) in the 4 and 24 h cohorts respectively. In C2C12 myocytes, there was a significant reduction in adiponectin gene expression following high doses of LPS (5 and 10 µg/ml), resulting in a 2.94- and 2.17-fold ($p < 0.05$) reduction in mRNA respectively.

Our results build on the increasing evidence that modulation occurs in the adiponectin system during inflammation. Previous authors have demonstrated a reduction in adipose tissue expression of adiponectin following LPS treatment⁶. We have demonstrated that adiponectin mRNA is present in mouse skeletal muscle which is in agreement with other authors^{3 4}. Confirmation of adiponectin mRNA in isolated myocytes assists in ruling out contamination by peri-muscular fat. In vivo, there was rapid marked reduction in adiponectin following treatment with high dose LPS. This change is also seen in isolated myocytes. Adiponectin was until recently believed to be an adipose specific molecule; however, in the light of studies showing its presence in other tissues, this has been disputed. It is therefore interesting, not only to confirm the presence of its mRNA in skeletal muscle but also to show a significant down regulation in vitro and in vivo in response to LPS stimulation. Skeletal muscle is an insulin-sensitive tissue and hyperglycaemia and insulin resistance are common in sepsis, and therefore this may imply a role for the adiponectin system in sepsis in tissues other than adipose tissue.

References: (1) Trayhurn P, Wood IS. *Br J Nutr* 2004; 92(3):347-55; (2) Ding G, Qin et al. *J Mol Cell Cardiol* 2007; 43(1):73-84; (3) Krause MP, Liu Y et al. *Am J Physiol – Cell* 2008; 295(1): C203-12; (4) Punyadeera C, Zorenc AH et al. *Eur J Endoc* 2005; 152(3): 427-36; (5) Takemura Y, Osuga Y et al. *Endoc* 2006; 147(7): 3203-10; (6) Leuwer M, Welters I, et al. *Pflügers Arch* 2009; 457(4):731-41.

Functional Electrical Impedance Tomography by Evoked Response (fEITER): monitoring for asymmetry in awake and anaesthetised patients

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fEITER is a novel imaging device which monitors changes in cerebral conductivity at 100 frames per second across the whole brain. We aimed to evaluate cerebral asymmetry using fEITER in relation to the depth of anaesthesia, as measured with bispectral index (BIS).

ASA I or II patients scheduled for elective surgery gave written, informed consent. 32 ZipprepTM (Covidien, UK) electrodes were placed on the patient's scalp using the 10-20 system. fEITER injected sinusoidal current of 1mA pk-pk at 10kHz. Continuous voltage data were recorded from non-injecting electrodes for 60s; during awake and anaesthetised conditions. BIS was simultaneously recorded with the BIS Vista monitor (Covidien, UK).

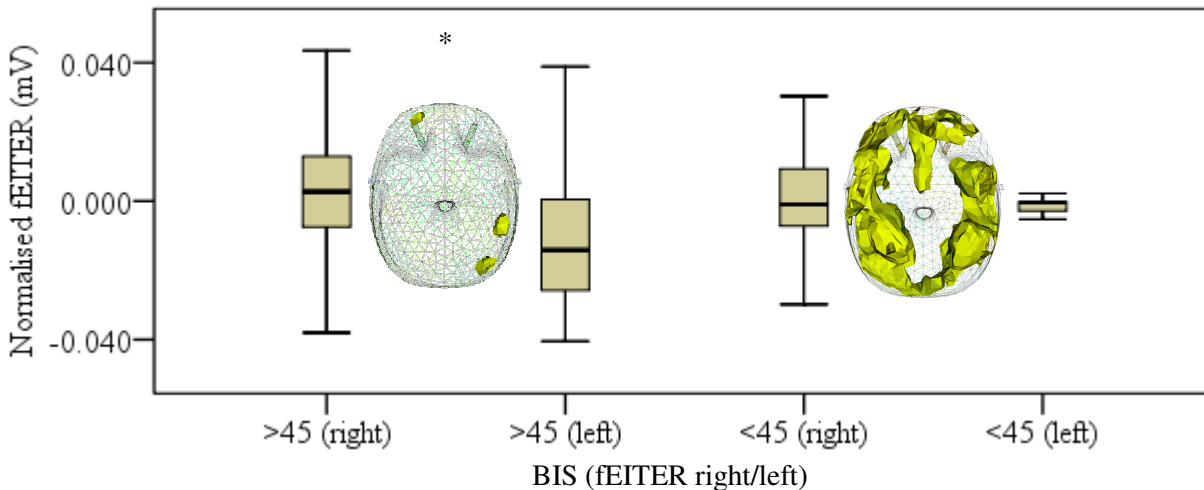


Figure 1. Single subject data (adult male). Box and whisker plots of fEITER conductivity changes at BIS >45 and <45, for measurement pairs: FT₈-T₈ (right) and FT₇-T₈ (left). * indicates significant differences between fEITER right and left ($p < 0.05$). Reconstructed awake and anaesthetised fEITER images are also shown.

fEITER right and left normalised conductivity values were compared for a central current injection at FP_z-O_z. We observed a significant difference ($p < 0.05$) between right and left hemispherical fEITER measurements at higher BIS levels (BIS >45 (fig.1)).

Previous findings demonstrated laterality during anaesthesia with bilateral BIS¹. fEITER measures sub-second conductivity changes during anaesthetic induction²; current results demonstrate cerebral laterality between the awake and anaesthetised state using fEITER.

References: 1. Pomfrett CJD et al. Delta sleep-inducing peptide alters bispectral index, the electroencephalogram and heart rate variability when used as an adjunct to isoflurane anaesthesia. *Eur J Anaesthesiol.* 2009;26:128-134; 2. Bryan A et al. Functional electrical impedance tomography by evoked response: a new device for the study of human brain function during anaesthesia. *Br J Anaesth.* 2011;106:428-9.

Acknowledgements: This study was funded by the Wellcome Trust.

Unilateral transversus abdominis plane (TAP) block for renal transplant recipients

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Postoperative pain after renal transplantation may be severe but administration of systemic opioids is limited by impaired renal function with the risk of respiratory depression.¹⁻³ TAP blocks have been shown to be effective after a variety of abdominal procedures,⁴⁻⁵ as they provide opioid-sparing effects and improve patient satisfaction.⁵ There has been no randomized controlled trial to evaluate the efficacy of TAP blocks in renal transplant recipients.

Forty-seven recipients were randomised to receive TAP block under ultrasound guidance after induction of anaesthesia with either 20 ml of levobupivacaine 0.5% (TAP group, n=23) or 20 ml of 0.9% normal saline (Control group, n=24). Postoperatively, all patients received paracetamol 1 g IV or orally every 6 hours and patient controlled analgesia delivering morphine 0.5 mg every 10 minutes intravenously on demand. The primary objective was to study morphine consumption in the first 24 hr after surgery. Secondary outcomes included assessment of the degree of sedation, respiratory depression, nausea and vomiting, and pruritus. Pain scores (VAS 0-10) were measured by nursing staff blinded to the randomisation, in theatre recovery and at 3, 6, 12 and 24 hr postoperatively in the ward. All variables were compared between the two groups using the Wilcoxon signed-rank test.

Fentanyl and morphine consumption were similar intraoperatively in both groups. There was no difference in pain scores between the two groups in the recovery room but morphine consumption (mean \pm SD) at this time in the TAP group was less than the Control group (2.2 mg \pm 3.75 mg, vs 4.1 mg \pm 2.8 mg, $p = 0.009$). There was no significant difference in total morphine consumption over 24 hr (21.7 mg \pm 12.8 mg vs 24.4 mg \pm 14.3 mg, $p=0.7$) between groups. No difference was recorded in pain scores, sedation scores, respiratory depression, nausea and vomiting or pruritis between the two groups at any time point. *Post hoc* analysis demonstrated a significant inverse correlation between the age of the patient and the amount of self-administered morphine at 12 and 24 hr ($p = 0.006$).

TAP blocks in renal transplant recipients only offer better pain relief in the immediate postoperative period. Morphine consumption in such patients receiving TAP block is comparable to control subjects over 24 hr postoperatively.

References: 1. Stein C, Schafer M, Machelska H. *J Pain* 2000; **1**:51–6; 2. Ghods AJ. *Saudi J Kidney Dis Transpl* 2007; **18**: 648–55; 3. Dean M. *J Pain Symptom Manage* 2004; **28**: 497–504; 4. McDonnell JG, O'Donnell BD, Curley G, et al. *Anesth Analg* 2007; **104**:193–7; 5. Belvay D, Cowlshaw PJ, Howes M, et al *Br J Anaesth* 2009; **103**: 726–30.

Effect of magnesium on analgesia from intrathecal local anaesthetics and fentanyl: a meta-analysis

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Intrathecal magnesium has been shown in rats to potentiate opioid antinociception, with minimal adverse effects.¹ Prospective randomised controlled trials (RCTs) have examined the effect of magnesium given with local anaesthetics +/- opioids, to assess its role as an adjunct to spinal anaesthesia. This meta-analysis examines the findings from these RCTs.

The keywords human, intrathecal, magnesium, and obstetric, were entered into Medline and EMBASE with no language restrictions to identify RCTs and published abstracts from scientific meetings. The Jadad Scale² was used to assess the quality of the manuscripts, which all scored between 3 and 5. RevMan statistical software[®] utilised inverse variance and a random effect model to calculate standardized mean difference (SMD) with 95% confidence intervals for continuous variables. The primary outcome was duration of analgesia (time from intrathecal injection to first analgesic request). Secondary outcomes were: onset of sensory block; time to maximal sensory block; onset of motor block; time to complete motor recovery; and total morphine consumption postoperatively.

Thirteen studies of 841 patients published between 2002 and 2010 were included. Addition of intrathecal magnesium increased duration of spinal analgesia (286 min in magnesium group vs. 195 min in controls, $p < 0.00001$). Magnesium did not exert a significant effect on onset of sensory or motor blockade, but led to a reduction in morphine consumption postoperatively (Table 1).

The additional of intrathecal magnesium may increase duration of spinal analgesia and reduce morphine consumption postoperatively, without any delay in time to maximal sensory block. With minimal side-effects, magnesium has a role as an adjunct in spinal anaesthesia.

Table 1: all times in minutes unless stated

	Number of studies/patients	Standardised Mean Difference and CI	p-value
Duration of analgesia	11/750	-1.54 (-2.19, -0.89)	<0.00001
Onset of sensory block	6/440	0.08 (-1.09, 1.26)	0.89
Time to maximal sensory block	7/500	-0.32 (-0.91, 0.28)	0.29
Onset of motor block	3/210	0.08 (-1.08, 1.23)	0.90
Time to complete motor recovery	8/538	0.35 (-0.32, 1.03)	0.30
Total postoperative analgesia (mg)	4/211	2.61 (0.96, 4.27)	0.002

References: Kroin JS, McCarthy RJ, Von Roenn N, et al. *Anesth Analg* 2000;90:913-7; Jadad AR, Moore RA, Carroll D, et al. *Controlled Clin Trials* 1996; 17: 1-12

The Radial artery to digit pulse transit time is highly pressure dependent

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Pulse transit time (PTT) can give a non invasive measure of arterial pressure.¹ It is often measured from the ECG R-wave to the trough of the photoplethysmograph wave. A typical PTT to the finger of a young subject is about 200 ms. Pressure wave transmission in the arterial system is related to several factors² which may affect the use of this index. We considered factors in the arterial system of the hand, by compressing the ulnar and radial arteries at the wrist.

We recorded ECG, non-invasive radial artery pressure (Colin CBM-700), finger photoplethysmograph and finger pulses in 12 volunteers. Signals were digitised at 10 KHz (Micro1401plus, CED). We detected waveform troughs and peaks using second derivatives and defined "RaDt" as the time from minimum radial artery pressure to the minimum of the photoplethysmograph waveform. Data were analysed with Octave and Prism5 (GraphPad). We modified arterial blood pressure in the hand by pressure on the radial or ulnar artery. All fingers gave similar results. Data are from the middle finger and are median (quartiles).

The pressure and photoplethysmograph timing were affected similarly by arterial compression. Fig. 1 shows typical recordings from the middle finger in subjects with radial and ulnar artery dominance. Pressing on the radial artery in the first subject increased RaDt from 69 (64-72) ms to 120 (118-122) ms. Ulnar artery pressure only increased RaDt to 70 (68-72) ms. In the other subject, the delay increased moderately with radial artery pressure, from 83 (82-83) ms to 98 (97-98) ms. Pressure on the ulnar artery increased the delay to 158 (154-162) ms. In the whole group, RaDt increased from 71 (64-78) ms to 98 (91-109) ms after radial occlusion, and from 69 (63-75) ms to 83 (74-92) ms after ulnar occlusion. Eight subjects showed radial dominance and two had ulnar dominance.

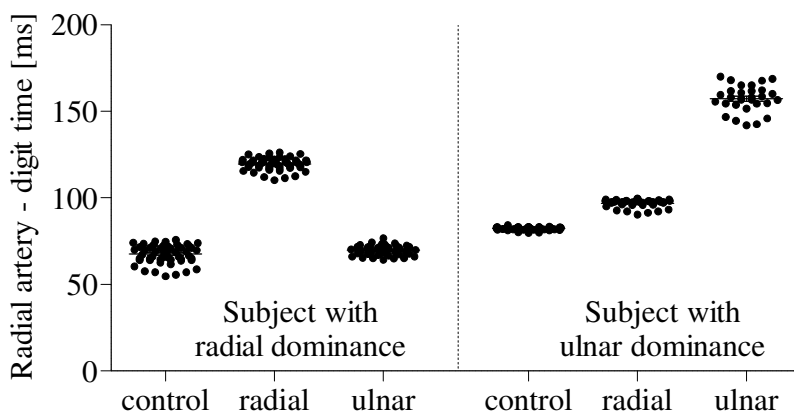


Figure 1

It appears that peripheral arterial transmission time comprises a substantial part of the PTT, and changes in small arteries can markedly affect the PTT. Estimations of pressure-volume relationships in finger vessels require accurate knowledge of the timing of events distal to the radial artery, and may not be simply done by aligning loops as done by previous workers.²

References: 1. Allen J *Physiological Measurement* 2007; **28**: R1-R39; 2. Shelley KH Murray WB Chang D *Journal of Clinical Monitoring* 1997; **13**: 223-8

Transcutaneous electrical acupoint stimulation for pain relief and decreasing opioid related side effects after total hip arthroplasty in elderly patients

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Transcutaneous electric acupoint stimulation (TEAS) has been considered as an effective pain relief alternative therapy for various types of pain. However, randomized controlled studies have not yet been done for treatment of acute pain after total hip arthroplasty (THA) in elderly patients. In this double-blind study, we investigated whether TEAS has any effect on complementary analgesia after THA compared with a sham control treatment.

Sixty eight elderly patients were enrolled and randomly divided into two groups. Six cutaneous self-adhesive electrode pads, sized 16 cm², were attached on the four acupoints (bilateral P6, LI4¹ ; ST36, GB31² ipsilateral to the surgery site) and connected with HANS Acupoint Nerve Stimulator. Group A received true TEAS in which all patients were stimulated in the standard dense-and-disperse (D-D) mode at a frequency setting of 2/100 Hz for 30 min before incision and at 2h, 4h, 20h and 44 h postoperatively. The patients in Group B received an identical intervention as in Group A but without electric stimulation. The intensity of stimulation was set at 0 mA for Group B and at 9-20 mA for Group A (depending on the patient's ability to tolerate the stimulation). Patient-controlled analgesia (PCA) was used in both groups for two days postoperatively. The amount of postoperative fentanyl via PCA and pain intensity on a visual analogue scale (VAS-10) were used to assess analgesia. The incidence of analgesia related side effects to fentanyl and optional medication use were recorded.

Sixty patients completed the procedure (30 TEAS VS 30 sham controls). There was no difference in pain intensity on VAS-10 between two groups at 24 h and 48 h postoperatively during rest or ambulation. However, Group A required 37% and 31% less fentanyl requirement than group B at 24 h and 48 h after surgery respectively. The incidence of analgesic-induced side effects such as nausea, vomiting and dizziness were significantly higher in group B than group A. The frequency of rescue medication in group A was significantly lower than group B.

Transcutaneous electric acupoint stimulation is an effective and complementary approach to reduce postoperative analgesic requirement and its related side-effects in elderly patients after THA.

References: 1. The editor. Common acupoints in upper limb. *Journal of Acupuncture and Tuina Science*, 2003; 6: 56-60; 2. The editor. Common acupoints in upper limb. *Journal of Acupuncture and Tuina Science*, 2004; 1: 61-63.

Imaging neural responses to affective and pain-related stimuli in chronic non malignant pain (CNMP) patients versus healthy controls

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The meaning of pain, in terms of its perceived physical and psycho-social causes and consequences, is different in CNMP compared to acute pain. This can affect the threat value of pain and the way in which it demands attention.^{1,2} There is a need to develop methods to investigate naturally occurring changes in chronic pain and responses to pain cues. The majority of functional Magnetic Resonance Imaging (fMRI) studies to date have focused on experimental acute pain and then made inferences about CNMP. This study investigated neural activity in affective and attentional regions in chronic pain patients versus healthy controls, as assessed by fMRI using a non-painful stimulus.

Fifteen CNMP patients with predominantly musculoskeletal pain were recruited and age and gender matched to healthy controls. All participants initially had a practice run in the mock scanner before scanning was performed on a 3T MR Scanner (GE Healthcare). During one acquisition (T2*-weighted for blood-oxygen level dependent contrast), subjects were shown activity of daily living photographs taken from the Photograph Series of Daily Activities database, a validated tool for assessing kinesiophobia. These photographs had already been validated in a previous study by the authors. Patients were asked to think about how they would feel, mentally and physically, if asked to undertake this activity and rate their anxiety using a button box. Additionally, a T1-weighted structural scan was acquired for data processing. Participants were also asked to complete a number of questionnaires on pain, function, fatigue and mood.

Various well-established pain regions showed significant activation in the patients compared to the healthy control subjects. The CNMP patients also showed significant activation in the default mode network (DMN) during the task; the DMN is typically characterised as regions of the cortex which are inactive during a task and active at rest in healthy subjects. The behavioural questionnaires illustrated that CNMP significantly affected the quality of patients' lives.

These findings demonstrate that chronic pain has a widespread impact on overall brain function, and aberrant DMN activity may underlie the cognitive and behavioural impairments accompanying chronic pain, supporting Beliki et al's³ proposition. This aberrant activity is thought to lead to the frontal lobe cortical loss and abnormal brain ageing seen in patients with CNMP. Using this method, we have assessed the impact of CNMP without inflicting acute, experimental pain and established a method that could be used in future research to examine whether these brain changes can be reversed.

References: 1. Buck RS, Morley S. *European Journal of Pain* 2006; 10: 385-398; 2. Crombez GC et al. *Journal of Psychosomatic Research* 1999;4 7: 403-410, 3. Beliki et al. *The Journal of Neuroscience* 2008; 28: 1398 –1403.

Acknowledgements: Welsh Institute of Cognitive Neurosciences Grant

Heterologous desensitisation of human GPR55 receptors

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There is growing evidence for a role for cannabis/cannabinoids in pain medicine but there is debate as to the members of the cannabinoid receptor (CB) family¹. Current and well accepted CB-receptors are classified as CB₁ and CB₂. However, there are two other orphan GPCRs; GPR55 and GPR119 which may be members of this family¹. GPR55 is coupled to increases in [Ca²⁺]_i via the G-protein G₁₃¹. In this study we examined the desensitisation profile of human GPR55 expressed in human embryonic kidney (HEK; HEK_{GPR55}) cells using [Ca²⁺]_i as a readout.

HEK_{GPR55} (provided by AZ or untransfected negative control) cells were loaded with Fura2 (5μM; a Ca²⁺ indicator dye) and intracellular Ca²⁺ ([Ca²⁺]_i) was measured as we have described previously². Cells were pre-stimulated with the muscarinic agonist carbachol (CCh:1mM) for 120sec then a concentration response curve to the GPR55 agonist L-α lysophosphatidyl inositol (LPI) was constructed. Next the reverse experiment was performed, pre-stimulation with LPI (1μM) followed by a concentration response curve to carbachol. Concentration response curves were analysed to obtain potency (pEC₅₀) and efficacy (E_{max}) using GraphPad Prism V5 and data are presented as mean±SEM.

In HEK_{GPR55} LPI produced a concentration dependent increase in [Ca²⁺]_i with a pEC₅₀ of 6.71±0.08 and an E_{max} of 75±9nM(n=9). In untransfected HEK cells there was an increase in [Ca²⁺]_i at 3 and 10μM. Therefore 1μM was chosen as the concentration that selectively activated GPR55. CCh produced a concentration dependent and saturable increase in [Ca²⁺]_i with a pEC₅₀ of 4.98±0.16 and an E_{max} of 123±18nM(n=5). CCh produced a concentration dependent and saturable inhibition of the 1μM LPI response with a pEC₅₀ of 4.99±0.24 and an E_{max} of 47±4%(n=5). LPI produced a concentration dependent and saturable inhibition of the 1mM CCh response with a pEC₅₀ of 7.60±0.15 and an E_{max} of 30±4%(n=5). There was a difference between the desensitisation and primary LPI responses (p<0.05, unpaired t-test).

We confirm that LPI is capable of activating GPR55³ but care is required at high concentrations. GPR55 undergoes heterologous bidirectional desensitisation when expressed in HEK cells but the degree is small. There was a ~10fold difference in the potency for LPI to activate and desensitise but this was not observed for CCh and may result from differences in lipophilicity.

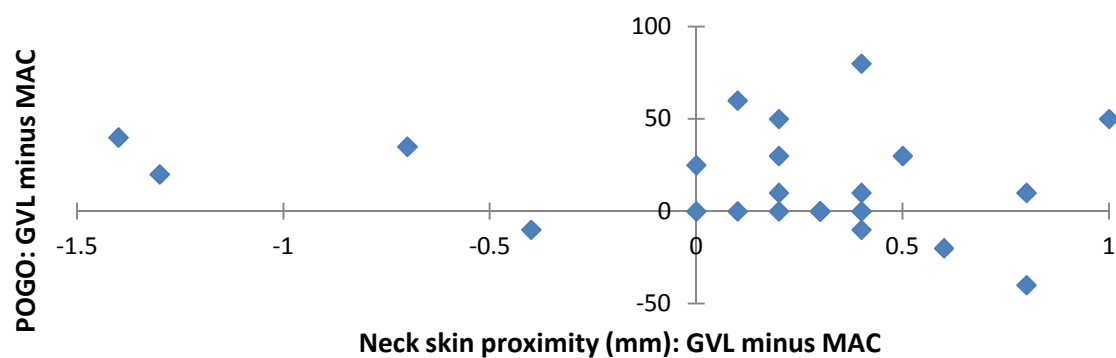
References: 1. Pertwee RG, Howlett AC, Abood ME, et al. *Pharmacol Reviews* 2010; 62:588–631; 2. Batuwangala MS, Calo G, Guerrini R, Ng LL, McDonald J, Lambert DG. *Naunyn Schmiedebergs Arch Pharmacol* 2009; 380: 451-7; 3. Whyte LS, Ryberg E, Sims NA, et al. *Proc Natl Acad Sci U S A* 2009; 106: 16511-6

Clinical comparison of Macintosh versus Glidescope blade tip proximity to neck skin surface during laryngoscopy
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In a previous study explaining the “Peardrop Effect” as a mechanism for difficult Macintosh laryngoscopy, reference was made to disposition of the blade tip when the tongue’s “inevitable residual volume” has to be accommodated in the submandibular space.¹ A necessary corollary of this hypothesis is that, all other things being equal, increased distance from neck skin surface to the blade tip should lead to worse laryngoscopic view. To study this problem, we planned a clinical trial in 24 patients to compare Macintosh laryngoscopy with the Glidescope Video Laryngoscope (GVL).

Crico-thyroid membrane and sternal notch landmarks were marked pre-operatively (as proxies for the laryngeal inlet). Each patient had consecutive laryngoscopies with Macintosh and then Glidescope. At maximum glottic exposure (recorded as POGO score, “Percentage of Glottic Opening”), lateral neck photographs were taken using a fixed distance from the patient’s midline. Equivalent photographs of each device on its own were also taken. Images were imported into “CorelDRAW Graphics Suite” (v. X3) and Bezier outlines of the blades were produced. These were then overlaid onto the lateral photographs to determine blade tip positions relative to the neck surface.

Glidescope (GVL) versus Macintosh (MAC)



The figure plots differences (Glidescope minus Macintosh) in POGO score and blade tip to skin proximity (in mm). Glidescope POGO scores were better than Macintosh in 13/24 patients (the same in 7; worse in 4). Skin proximity was the same for both (i.e. -0.1 to +0.1mm) in 4, with Glidescope closer in 16 and further away in 4.

Overall, despite our expectations, there was no clear gradation in POGO results relative to blade tip-skin distance for either Macintosh or Glidescope. However this overlay method is likely to prove useful in comparing indirect laryngoscope blade tip positioning (i.e. functionality²) relative to Macintosh.

References: 1. Horton WA, Fahy L, Charters P. *Br J Anaesth* 1990; 65: 801-805. 2. Darshane S, Ali M, Dhandapani S, Charters P. *Eu J Anaesth* 2011; 28: 175-80.

Efficacy of pre-emptive bilateral superficial cervical plexus block in thyroid surgery – a meta-analysis

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Bilateral Superficial Cervical Plexus Block (BSCPb) is used in patients undergoing thyroid surgery for postoperative pain relief. There have been several randomised control trials comparing it done prior to skin incision to that done at the end of surgery, with or without saline control. We conducted this meta-analysis to assess the influence of pre-emptive BSCPb on postoperative analgesia requirements.

The keywords bilateral cervical plexus block and thyroid surgery were entered into Medline and EMBASE with no language restrictions to identify RCTs and published abstracts from scientific meetings. We found 8 RCT's of 766 patients published between 2001-10 in which ropivacaine with or without clonidine, or bupivacaine/levobupivacaine with or without epinephrine had been used. The Jadad score¹ was 1-5 for the RCT's retrieved. The primary outcome variable was the number of patients requiring postoperative rescue analgesia in the pre-incision group. Secondary outcomes were: number of patients requiring analgesia who had BSCPb performed at the end of surgery; intraoperative analgesic requirement in both groups; and length of hospital stay in the pre-incision group. Dichotomous data was summarised using the odds ratio (OR), M-H method; and continuous variables by inverse variance and standardised mean difference (SMD). Analyses were done using Review Manager V5.1 software and the random effects model.

If given pre-emptively, BSCPb probably reduces postoperative analgesic requirements and length of hospital stay, but has no effect on intraoperative analgesia usage (Table 1).

Table 1: Outcomes compared with saline (control) group.

Outcomes	No of patients/RCT's	OR, 95% CI	P value
Rescue analgesia in pre-incision group	142/2	2.22 [0.91, 5.46]	0.08
Rescue analgesia in post-surgery group	243/3	1.91 [0.74, 4.95]	0.18
Intra-operative analgesia requirement: pre-incision group	142/2	2.94 [-0.76, 6.64]	0.12
Intra-operative analgesia requirement: post-surgery group	143/2	1.14 [-1.4, 3.67]	0.38
Length of hospital stay (pre-incision only)	241/2	0.35 [0.08, 0.61]	0.01

References: Jadad AR, Moore RA, Carroll D, et al. *Controlled Clin Trials* 1996; **17**: 1-12

Isoflurane induced prostate cancer chemotherapy resistance *in vitro*

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Surgery is the most effective treatment for solid tumors. Recently published work showed that anaesthetic techniques and/or anaesthetics may have an impact on cancer recurrence after surgery (1) although the responsible mechanisms for those remain elusive. Chemotherapy is often used before, during or after surgery. Furthermore, any potential interactions between anaesthetics and chemotherapy on cancer progression remain unknown. The aim of the present study is to investigate whether isoflurane can induce resistance to chemotherapy in prostate cancer *in vitro* and the potential mechanisms behind this.

Human prostate cancer cell (PC3) line (a gift from Dr Charlotte Bevan from Hammersmith hospital, London) was cultured and then treated with 2% isoflurane in air balanced with 5% carbon dioxide for 2 hours, while cells in control group exposed to air balanced with 5% carbon dioxide only. After gas exposure, the cells were recovered with normal culture media for 24 hours. Cells were then cultured in medium contained docetaxel at the doses up to 100nM for another 48 hours and subjected to cell viability assessment with MTT assay. Other cohort cultures were exposed to isoflurane up to 2% under normoxic conditions at 37°C for 2 hours. Cell lysates were harvested at 0 hr time point up to 24 hrs after isoflurane exposure for western blotting to measure HIF-1 α expression.

Overall, isofurane exposure increased cell viability in the presence of docetaxel at the dose up to 100 nM . Isoflurane exposure also significantly increased the expression of HIF-1 α in a time- and dose-dependent manner.

Isoflurane induces resistance to chemotherapy in prostate cancer cells, which may be mediated by HIF-1 α upregulation.

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Is a reduced albumin concentration effective for albumin dialysis?

A Labib, J Tattersall*, A Lewington*, MC Bellamy. *St James's University Hospital, Leeds*

Despite major advances in acute liver failure, prognosis remains poor with a 33% mortality rate and 25% transplant rate in the US.¹ In 2010, the number awaiting a transplant has risen by 11%, with an average waiting time 149 days.² Two patients die every week whilst awaiting a transplant.³ Modern methods available to support patients with acute liver failure, either as a bridge to transplantation or to substitute some of the lost liver functions can be broadly classified into artificial and bio-artificial (cell-based) techniques. The molecular adsorption and recirculation system (MARS) is an FDA approved albumin dialysis liver support system. Single pass albumin dialysis (SPAD) provides some advantages, including significantly less albumin usage and non-proprietary equipment. However, the minimum effective albumin concentration in the dialysate solution has not been established.⁴

Following on our initial studies in a model simulating patients with acute liver failure, we set out to determine the lowest dialysate albumin concentration necessary to achieve adequate bilirubin clearance. Serial experiments (image 1) were conducted using human albumin in concentrations of 4%, 2%, 1% and 0.5% against a patient compartment spiked with 10mg/dL bilirubin in 4% human albumin solution. A standard hollow fibre dialyser membrane was incorporated in the circuit and flow rate adjusted to 200ml/min on the patient side versus 10ml/min on the dialysate side.

Table 1: % change of light transmission on patient and dialysate side

Time (min)	Patient	Dialysate 4%	Dialysate 1%	
0	26.80%	50.10%	45.40%	Our serial experiments and photometric assay confirmed consistent reduction of bilirubin concentration on the patient side accompanied by simultaneous rise of bilirubin concentration in the waste bag across all dialysate albumin concentration. Significant bilirubin clearance was achieved at 1% albumin dialysate concentration.
20	20.20%	8.40%	7.70%	
40	26.00%	10.80%	9.80%	
60	25.10%	13.70%	12.40%	
80	31.60%	17.30%	16.10%	Our results suggest that lower albumin concentration can be used effectively to facilitate bilirubin clearance. This is in keeping with previous studies. ⁵ Less human albumin utilisation will have a significant cost implication and improve the clinical feasibility of SPAD.
100	28.80%	26.30%	24.20%	
120	29.70%	1.20%	1.20%	

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Effects of melatonin in a rat model of sepsis

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The mortality rate of patients with sepsis induced organ failure remains high. The precise pathogenesis of such organ failure is unknown, but oxidative stress mediated mitochondrial damage occurs. In our *in vitro* studies we have shown that melatonin and its metabolite 6-hydroxymelatonin reduce oxidative stress and mitochondrial dysfunction.¹

We assessed the effect of melatonin on plasma creatinine concentration (renal function), alanine aminotransferase activity (ALT, hepatic cellular function) and interleukin-6 (IL-6) levels following a septic insult in a rat model. Rats (~500g) were anaesthetized with isoflurane and a tracheostomy was performed to permit ventilation. To allow intravenous access a cannula was inserted into the tail vein. Rats were then randomly allocated to receive either saline alone, a 1ml bolus of i.v. 0.1 mg/kg lipopolysaccharide plus 1 mg/kg peptidoglycan G (LPS/PepG), followed by either a bolus of melatonin (3mg/kg i.v.) or saline. All animals then received an i.v. infusion of saline. After 6 h blood and tissue was removed for analysis.

Creatinine, ALT and IL-6 were higher in animals which received LPS/PepG compared to saline only (Figure). In rats treated with LPS/PepG plus melatonin, creatinine, ALT and IL-6 were lower than LPS/PepG and saline.

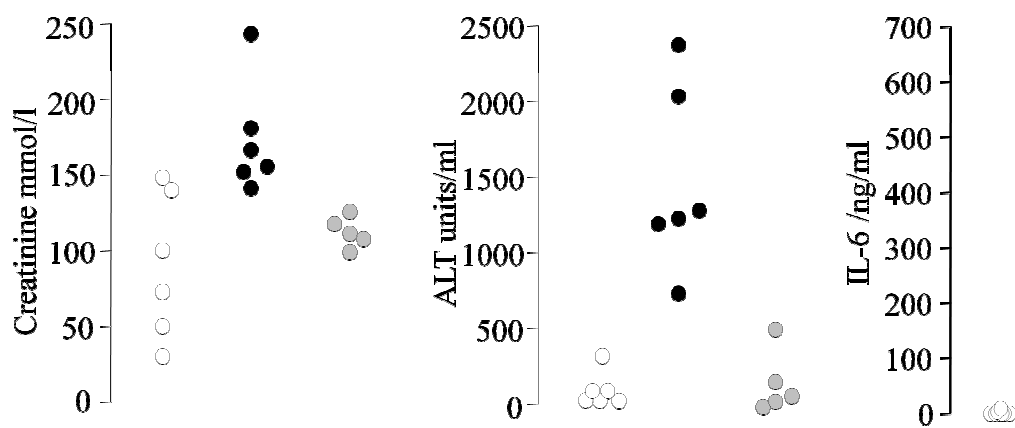


Figure: Creatinine, ALT and IL-6 in rats treated with saline only (open circles), LPS/PepG plus saline (black circles) or LPS/PepG plus melatonin (grey circles).

We have shown that melatonin treatment results in decreased biochemical measures of organ dysfunction following an inflammatory insult. We have also shown that melatonin reduces IL-6 concentrations in a rat model of sepsis.

1. Lowes DA, Almawash AM, Webster NR, Reid V, Galley HF. *Br J Anaesth* 2011 [in press].

Patient safety incidents associated with displaced or obstructed tracheostomies: Comparison of levels of harm between critical care and ward environments

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Patients with tracheostomies have a greater chance of some harm occurring if an airway incident occurs on a hospital ward compared with incidents occurring in Intensive Care Units (ICU)^{1,2} (OR = 7).³ The aim of this study is to compare the severity of harm occurring in these locations when a tracheostomy incident occurs.

We identified patient safety incidents associated with airway devices reported to the UK National Patient Safety Agency over a 2 year period.^{2,4} Post placement tracheostomy incidents were stratified into 3 ordered strata; completely or partially displaced and obstructed. Outcomes were scored in ascending ordered categories of severity from 1 to 6.⁵ The effects of location, incident and outcome were analysed using loglinear analysis of multi-way contingency tables. Linear mixed model analysis using maximum likelihood estimation of the log transformed scores was performed with Kruskal-Wallis and Mann-Whitney U used as backup tests. Cuzick test was used for trend in ranks. Results are presented as geometric mean with 95% confidence interval (CI). Significance was defined at $P < 0.05$ (two-sided) with Bonferroni corrections as appropriate.

N=494 incidents were classified by location into ICU (n=218) or ward (n=276). Harm scores were significantly higher for ward incidents vs ICU (loglinear $P=0.011$). There was a significant trend, with rising severity scores, from complete through partial displacement, to tube obstruction (Cuzick $P < 0.0001$). The interaction of location and incident demonstrated significant differences in harm scores occurring with a completely displaced tracheostomy on the ward (2.14 [95%CI 2.03 – 2.25]) vs ICU (1.55 [1.42 – 1.69], Mann-Whitney U $P < 0.0001$).

Whilst ward patients would be expected to be less dependent than ICU patients, they come to greater harm when a tracheostomy incident occurs. Different levels of staffing, observation, equipment and infrastructure may account for the difference in severity arising from the completely displaced tracheostomy incidents. Respiratory distress with a partially displaced or obstructed tracheostomy may alert staff, whereas complete displacement may result in a delayed diagnosis if not immediately observed.⁵ In ICUs, complete displacement may be more likely to result in a trial without the device if the patient is in a weaning phase, whereas ward patients usually require a long term tracheostomy, necessitating replacement. Airway intervention (such as replacing the tracheostomy) is classified as 'harm' in the reporting system, which may partly explain the observed differences.

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Is preoperative anaemia associated with a poorer outcome following colorectal cancer surgery?

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The potential adverse outcomes associated with perioperative blood transfusion are widely documented.¹⁻⁴ Less is written about the impact of preoperative anaemia, and more specifically its use as an independent predictor of outcome and the benefit of non-transfusion correction prior to cancer surgery. Here we look specifically at the consequence of preoperative anaemia in colorectal cancer surgery patients at a large tertiary centre in the UK.

Electronic records of all 100 patients undergoing colorectal cancer resection surgery from August 2009-February 2010 were reviewed and each patient identified as anaemic or non-anaemic according to local reference ranges (11.1g/dl female, 13.1g/dl male) and the lowest preoperative haemoglobin seen. Length of stay and red blood cell transfusion requirements were pre-specified primary endpoints. Secondary outcomes were readmission rate and mortality. Genders were combined for data analysis.

The preoperative haemoglobin (mean (range)) was 10.0g/dl (5.9-12.8) for anaemic patients (n=51), and 13.9g/dl (11.3-16.6) for the non-anaemic patients (n= 49). The groups were similar in terms of age, gender, ASA grade and American Joint Committee on Cancer grading. Preoperative anaemia was associated with a statistically significant difference in terms of length of stay, transfusion requirements, readmission rate and mortality at one year.

	Anaemic (n=51)	Non-anaemic (n=49)	p-value
Length of stay (LOS)	17 (4-48[11-31])	7 (3-40[5-11])	p<0.001
1-year mortality	20 (40%)	6 (12%)	p<0.003
30-day readmission rate	14 (27%)	4 (8%)	p<0.02
Required blood transfusion	42 (82%)	7 (14%)	p<0.001

Table 1. Median (range [IQR]) LOS (days), (Mann-Whitney U). Mortality, readmission rate and transfusion requirements are presented as number of patients (%), (Fisher's exact test).

As illustrated in table 1, we have found that preoperative anaemia is associated with inferior outcomes following colorectal cancer resection surgery. A formal trial is required to determine the nature of this association, and whether correction of preoperative anaemia is beneficial.

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Visibility of echogenic and non-echogenic needles in the Thiel cadaver

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Despite the introduction of ultrasound technology, no reduction in the incidence of postoperative neurological damage has been observed. A recent innovation in needle design, the echogenic regional block needle, has an intermittent textured surface which increases the reflection of ultrasound waves. Echogenic single shot needles show improved visibility at steep needle insertion angles (in-plane) and shallow needle insertion angles (out-of-plane) compared to non echogenic needles¹. An echogenic Touhy needle (Pajunk, Newcastle, UK) has since been introduced and an opportunity existed to assess the visibility of this new needle.

Therefore, the primary objective of this study was to compare the visibility of the echogenic Touhy needle (ET), [SonoLong] with an echogenic single injection needle (ES), [SonoPlex], and a non-echogenic Touhy needle (NT), [PlexoLong]. Secondary objectives were to compare tip visibility, needle visibility scores in-plane and out-of-plane and at different angles (30°, 45°, 60°, 75°). For power analysis in-plane mean visibility scores were assumed to be 3, 3, and 2 for the ET, ES and NT needles respectively, and 3, 3, 1.5 and 1.5 for the 30°, 45°, 60° and 75° needle angles¹. Using a randomized block ANOVA power analysis with 3 needles and 4 angles, 72 injections were needed within 6 blocks, and a total of 144 to account for in-plane and out-of-plane injection.

For the study, an independent operator managed the randomisation, study conduct and data collection, and another performed ultrasound scanning and needle injection. Two anaesthetists acted as independent assessors of visibility using a 5-point Likert score, where 0=poor visibility and 5=excellent visibility. Needles were inserted 2cm in and out of the biceps and deltoid muscles of a Thiel embalmed cadaver. Needle movement was visualised using ultrasound (Zonare, Palo Alto, CA) and video recorded. Statistical analysis used NCSS, Utah and Vassarstats.com.

Visibility data were non parametric. Correlation between raters was 0.72 (95%CI: 0.63-0.81) using weighted Kappa. Agreement was 0.67 (95%CI: 0.56-0.76). In plane, median (IQR) visibility scores were 4.5 (3.5-5.0), 4.5 (3.75-5.0) and 2.5 (2.0-3.0) for the ET, ES and NT needles respectively, p<0.001 using the Friedman test. The needle tip was visible in 79%, 83% and 25% of insertions. Out of plane, the median (IQR) visibility scores were 3.75(3-4.25), 3 (2.75- 4) and 2 (1-5-2.5), p<0.001 for the ET, ES and NT needles respectively

In conclusion the ET and ES needles are more visible than the standard NT needle both in plane and out of plane.

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Substrate oxidation during exercise: switch with age?

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Pre-operative carbohydrate (CHO) loading is a key component of the enhanced recovery programme¹. However, there is little published work on how ageing individuals respond to a carbohydrate load during stress. This aim was to investigate age related changes in substrate oxidation when an intravenous glucose load is delivered during exercise.

After Ethical Committee approval, 12 trained healthy male volunteers were recruited: 8 young and 4 older. In addition, data from 4 older subjects from a previous experiment were considered separately. Each subject underwent two experiments: the first involved a standardized exercise protocol (40 minutes of steady state cycling at 60% peak oxygen consumption) under the conditions of a hyperglycaemic glucose clamp (infusion of 20% w/v D-glucose to maintain the serum glucose at 10 mmol.L⁻¹). The second or control experiment followed the same exercise protocol, but 0.9% w/v saline was infused instead of glucose. Carbohydrate and fat oxidation rates were estimated from respiratory measurements taken at 20 and 40 minutes of exercise. Data are presented as mean (SD) or 95% confidence interval (CI) and analyzed using repeated measures ANOVA with Tukey post-tests and linear mixed models. Two-sided $P < 0.05$ was defined as significant.

Ages were 22.4 (2.9) and 69.0 (7.6) years in the younger (n=8) and older (n=4) groups respectively. There was a significant effect of age group on CHO oxidation during exercise ($P=0.0025$), with the younger group demonstrating higher CHO oxidation rates (2.19 g.min⁻¹; 95% CI 1.84 to 2.54) compared to the older group (0.98 g.min⁻¹; 95% CI 0.48 to 1.48). Glucose infusion significantly ($P=0.04$) enhanced CHO oxidation in the younger group by 0.29 g.min⁻¹ (95% CI 0.016 to 0.56). In the older group, glucose infusion resulted in a nonsignificant reduction of CHO oxidation of -0.38 g.min⁻¹ (95% CI -3.36 to 2.57). Although the difference in fat oxidation of 0.22 g.min⁻¹ (95% CI -0.073 to 0.52) due to age group was not significant ($P=0.13$), there was a significant interaction ($P=0.0088$) of age group and infusion, with fat oxidation increased in older and decreased in younger subjects during glucose loading. Sensitivity analysis including the 4 older subjects from a previous experiment supported the findings.

During exercise it appears that glucose loading enhances oxidation of CHO in younger and fat oxidation in older subjects. This implies that there may be a possible switching of substrate preference which is age dependent.

Acknowledgement: This study was funded by Liverpool John Moores University

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Use of the Peri-Anaesthetic Care Unit as a Critical Care Facility: Evidence for Adverse Outcomes

AW Scott *, SE Marsh *, A Breen*, MC Bellamy. *Intensive Care Unit, St James's University Hospital, Leeds*

At times of peak pressure, post anaesthetic care units (PACU) are increasingly used as a critical care overflow facility. We therefore aimed to establish current use of a tertiary regional unit PACU as an overflow critical care facility, and to compare patient outcomes between patients admitted via PACU and directly to ITU.

Patients admitted between 1st December 2010 - 31st March 2011 were considered. Patients were identified using the Ward-Watcher ITU management system. Admissions via PACU were also discovered through informal recording methods instituted by PACU staff. Where data were available, age, sex and ICNARC and APACHE II scores were compared between PACU and direct admissions. Overall length of ITU stay and total ventilated days were compared. Results were analysed using the SPSS statistics package.

No single method of recording of ITU admissions via PACU was found. Recording was spread between the Ward Watcher system, and informal records instituted by PACU staff: paper sheets and a hand-written book. 279 ITU admissions were identified in the period. 76 patients were admitted via PACU. Data were not present for 32 patients. 44 patients had recorded ICNARC and APACHE data. The PACU and direct-admission groups did not show significant differences in age, sex or ICNARC or APACHE II scores, with mean APACHE II predicted mortalities of 35.9% (PACU) and 36.3% (Direct). ITU mortality was not significantly different (PACU 26.6% vs Direct 27.27%, $p > 0.05$) PACU-admitted patients on average had a total length of stay of 11.6 days vs. 4.5 days for direct admissions ($p = 0.003$). PACU-admitted patients had a mean number of ventilated days of 9.9 vs 2.1 for direct admitted patients ($p < 0.0001$). The Trust tariff of £1760 per ITU bed day was used to calculate financial implications. The 32 patients lost to Ward Watcher data represent £253,440 to £653,312 in lost directorate revenue. The 76 patients considered represent an extra 539.6 bed days, at a cost of £949,696.

Our findings support the hypothesis that a lead-time in PACU is detrimental to subsequent patient care in terms of resource utilisation. Our data are not sufficiently robust to comment on ultimate outcome as it is difficult to ensure like-for-like admissions because of the haphazard nature of clinical and managerial data recording. We recommend a single, rigorous method of recording ITU admissions via PACU should be instituted. All admissions via PACU should be coded in compliance with the ICNARC minimum data set. Until more robust data are available, all such admissions should be flagged as critical incidents and a management response be sought. Length of stay and ventilated days should be considered in any decision regarding PACU admission versus inter-hospital transfer. A need for PACU admission should be regarded with grave concern as a deteriorating Critical Care bed crisis.

Antinociceptive effects of the bifunctional opioid UFP-505.

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Morphine used in chronic cancer pain activates MOP(μ) opioid receptors producing analgesia and tolerance¹. If DOP(δ) receptors are concurrently blocked, analgesia with reduced tolerance results¹. UFP-505 is a MOP agonist/DOP antagonist² and here we present first *in vivo* use in rats.

We have studied i.t. (catheter L5/L6 interspace) drug administration in male Wistar rats. Antinociception was assessed using the tail-flick (TF) assay by recording tail-flick latency (TFL) in response to radiant heat (cut off 15sec) prior to treatment (baseline), then at 15, 30, 60, 90 and 120 mins. Drugs were administered either acutely or after repeated administration. Acutely, multiple doses of UFP-505 (1-50nmol i.t.) and morphine 10nmol were administered and their TFL was assessed in order to determine the equianalgesic doses. In repeated dosing (up to 5days), 10nmol UFP-505 or 10nmol morphine were administered i.t. once daily and TWL assessed. Spinal cord and frontal cortex quantitative-PCR MOP and DOP receptor gene transcription³ are presented for acute (120mins) administration. Data are mean \pm SEM(n).

Catheter retention was a major problem. Acute antinociceptive data for UFP-505 and morphine are shown in Figure 1 (Day 1 repeated administration data were similar). After 3 days repeated administration there was evidence of morphine, but not UFP-505 tolerance. In spinal cord MOP and DOP mRNA increased after acute morphine and UFP-505 (~2 fold, $p < 0.05$). In frontal cortex MOP and KOP mRNA increased after acute morphine and UFP-505 (2-4 fold, $p < 0.05$). These data indicate that MOP/DOP bifunctionals may provide antinociception with reduced tolerance.

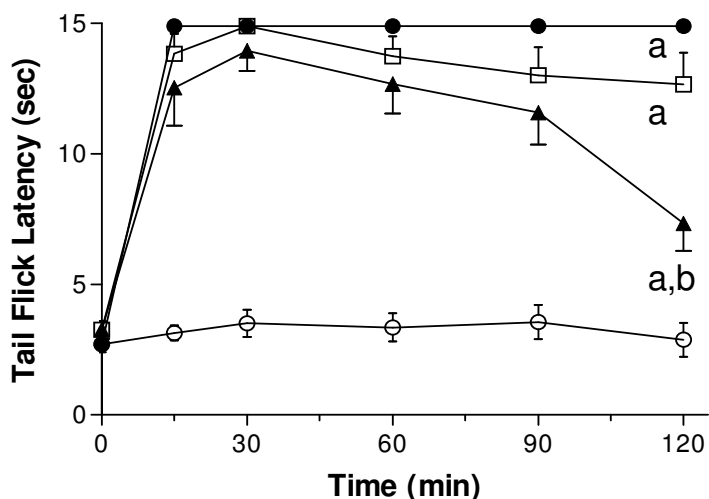


Figure 1: Antinociceptive effect of UFP-505 (●50nmol, n=3; □10nmol, n=8) and morphine (▲10nmol, n=5), in the Tail Flick assay. a: $p < 0.05$, increased compared to saline (○, n=10), b: $p < 0.05$, decreased compared to UFP-505 10nmol).

Acknowledgement: Funded by HOPE Against Cancer and Schachter travel award (ND) from Brit Pharm Soc.

References: 1. Dietis N *et al.* Brit J Anaes 2009;103:38-49; 2. Balboni G *et al.* ACS Chem Neurosci 2010;1(2):155-164, [3]. J. McDonald, *et al.* Br J Anaesth. 2010;104(6):698-704

Location information

Directions to the Liverpool Medical Institution (www.lmi.org.uk)

If approaching from the end of the M62, follow signs for the City Centre, down Edge Lane, past Retail Park and GPT on the left hand. Continue to follow City Centre signs until you see brown tourist signs for Cathedrals. Follow these signs until you see sign for RC Cathedral with Blackwells University Book Shop on your left. Turn left and continue past the Cathedral until the road branches off to the left. At this junction the Medical Institution is directly opposite you. The entrance is at the rear of the building immediately behind Lloyds Bank.

Suggested accommodation

1) Budget: www.hattersgroup.com/liverpool

Nice hostel within walking distance of the LMI. To be booked via the web-link. Single room £39.

2) Traditional Liverpoolian: Feathers Liverpool Hotel

Across the road from the LMI. To be booked via 0151 709 9655, ask for Kelly Shaw and quote "university". Single room £59.95.

3) The posh option: Hope Street Hotel

Within walking distance from the LMI. To be booked via 0151 709 3000, ask for Carly McCracken. Single room £107.

4) Nicely converted town house in the Business District/City Centre: Heywood House Hotel

Short hop by taxi. To be booked via 0151 224 1444, quote "university". Single room £55.

All prices exclude breakfast.



ANAESTHETIC RESEARCH SOCIETY ~ SUMMER MEETING

Liverpool Medical Institution, 114 Mount Pleasant, Liverpool, L3 5SR

30th June & 1st July 2011

Registration form ***Please complete one form for each delegate***

Name & title:

Address:

.....

Tel/fax:

Email:

Registration -- 30th June 2011 *(including lunch)* £ 45 places

Registration -- 1st July 2011 £ 35 places

Society Dinner (Yuet Ben, Upper Duke Street ~ Northern Chinese) £ 35 places

Wine will be available at the dinner, and is included in this price

TOTAL: £

Special dietary / mobility requirements:

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Please return to: Jenny McGreaveney / June Robson, CLRN Cheshire & Merseyside, Liverpool Science Park IC 2, 146 Brownlow Hill, Liverpool, L3 5RF; tel. +44-(0)151-331 5139; email jennifer.mcgreavey@rlbuht.nhs.uk

Please include payment by cheque, made payable to "Anaesthetic Research Society"

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Places for Society Dinner are limited, and these have to be confirmed well in advance. If you wish to attend the dinner, please confirm your registration by 24th June 2011.

Registration for the meeting will be possible at the venue on the day of the meeting, but places for the dinner may not be available.