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**D.S. ROSENGARTEN
SURGICAL TRAINEE RESEARCH PRIZE 2020**

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ABSTRACT BOOKLET

**PRESENTED BY
MRS CANDICE ROSENGARTEN**

**CHAIR
MR JAMES LEE**



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2020**

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MR DAVID SAM ROSENGARTEN



The D.S. Rosengarten Surgical Trainee Research is named in honour of David Rosengarten. David learnt his surgery at the Alfred Hospital before undertaking research and Post-Fellowship training in Vascular Surgery at the Royal Postgraduate Medical School, Hammersmith. He returned to the Alfred and held appointments in the Department of Surgery and the Vascular Unit. David was appointed Head of the Vascular Surgery Unit at the Alfred in 1987, the position he held until his sudden death in 1994. David was recognised for his encouragement of research, for an enduring interest in surgical audit and his involvement in registrar training. This prize is his enduring memorial.

A 4-tier protocolised radiological classification system for leaks following sleeve gastrectomy

Presenter: Yazmin Johari

Objectives: To develop and validate a classification of sleeve gastrectomy leaks able to reliably predict outcomes, from protocolised CT findings and readily available variables.

Summary of Background Data: Leaks post sleeve gastrectomy remain morbid and resource-consuming. Incidence, treatments and outcomes are variable, representing heterogeneity of the problem. A predictive tool available at presentation would aid management and predict outcomes.

Methods: From a prospective database (2009-2018) we reviewed patients with staple line leaks. A Delphi process was undertaken on candidate variables (80 to 20). Correlations were performed to stratify 4 groupings based on outcomes (salvage resection, length of stay, and complications) and predictor variables. Training and validation cohorts were established by block randomization.

Results: A 4-tiered classification was developed based on CT appearance and duration post-surgery. Inter-observer agreement was high ($\kappa=0.85$, $p<0.001$). There were 59 patients, (training:30, validation:29). Age 42.5 ± 10.8 vs. 38.9 ± 10.0 years ($p=0.187$); female 65.5% vs. 80.0% ($p=0.211$), weight 127.4 ± 31.3 vs. 141.0 ± 47.9 kg, ($p=0.203$). In the training group, there was a trend towards longer hospital stays as grading increased (I=10.5days; II=24days; III=66.5days; IV=72 days; $p=0.005$). Risk of salvage resection increased (risk ratio grade4=9; $p=0.043$) as did complication severity ($p=0.027$). Findings were reproduced

in the validation group: risk of salvage resection ($p=0.007$), hospital stay ($p=0.001$), complications ($p=0.016$).

Conclusion: We have developed and validated a classification system, based on protocolised CT imaging that predicts a step-wise increased risk of salvage resection, complication severity and increased hospital stay. The system should aid patient management and facilitate comparisons of outcomes and efficacy of interventions.

Risk of Intraoperative Hypotension in Posterior Retroperitoneoscopic Adrenalectomy vs Transperitoneal Laparoscopic Adrenalectomy

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Introduction: Hemodynamic instability is a major challenge during adrenalectomy.

We hypothesized that the prone jack-knife position for posterior retroperitoneoscopic adrenalectomy (PRA) is associated with greater intraoperative hypotension than transperitoneal laparoscopic adrenalectomy (TPA). The aim of this study was to compare intraoperative hemodynamic parameters between PRA and TPA.

Methods: A retrospective study of patients undergoing PRA and TPA from 2008 to 2019. The primary outcome was intraoperative hypotension defined by mean arterial pressure (MAP) <60 mm Hg or a need for ≥ 2 intravenous vasopressors at least 30 minutes after anaesthetic induction.

Results: Overall, 108 patients met the inclusion criteria; 33 (30.6%) had pheochromocytoma, 26 (24.1%) Conn's syndrome, 8 (7.4%) Cushing's disease, and 41 (38.0%) non-functioning adrenal tumours. Of these, 68 (63.0%) underwent PRA and 40 (37.0%) TPA. Age, sex, body mass index, pre-induction blood pressure (BP), number of pre-operative anti-hypertensives, and histopathological diagnosis were similar in the 2 groups. Multivariate analysis showed PRA was more likely to be associated with a lowest MAP of < 60 mmHg (OR 4.44, 95% CI 1.27-15.54, P=0.02), and a need for ≥ 2 intravenous vasopressors (OR 5.44, 95% CI 1.52-19.46, P=0.009) compared with TPA. When pheochromocytoma patients were excluded from analysis, PRA patients were more likely to require ≥ 1 intravenous vasopressors (OR 21, 95% CI 4.61-96.65, P=0.001); but the risk of the

lowest MAP being < 60 mmHg was similar in both groups. PRA was associated with reduced operative time (P=0.01) and length of hospital stay (P=0.03) compared with TPA.

Conclusion: While PRA offers several advantages over TPA, it carries a greater risk of intraoperative hypotension. Both surgeons and anaesthetists should be aware of this association to minimise adverse outcomes.

Graft-wound interactions in a murine full-thickness wound model

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Background and aims: Little is known about the biomolecular changes of the wound bed and the mechanism by which skin grafting accelerates wound healing. Our aims were to identify biomolecules related to successful graft take following establishment of a full-thickness wound mouse model.

Methods: An autologous full-thickness skin graft (FTSG) or Biodegradable Temporising Matrix (BTM) was grafted on a full-thickness wound bed on SKH-1 hairless mice. RNA and protein were extracted from the wound bed following a cull at inflammation, proliferation and remodelling stages of healing wounds and analysed for inflammatory (TNF- α , IL-1 β , IL-6, CXCL-1), anti-inflammatory (IL-10), proliferation (TGF- β 1, VEGF) and remodelling markers (MMP-2, collagen I and III) using Q-PCR and antibody arrays respectively. Results from the full-thickness wounds were compared to FTSG and BTM wounds.

Results: Grafts for all mice were considered successfully taken at endpoint. The majority of the inflammatory markers peaked at D1 at an mRNA level. Collagen deposition was significantly higher at Day 11, 14 and 21 compared to D1, 2, 5 and 8 in the full-thickness wound model. H&E staining demonstrated the appearance of less inflammatory cells in grafted wounds compared to ungrafted wounds. Expression of IL-6, CXCL-1 and MMP-2

were significantly higher in wounds with FTSG compared to BTM at D5. VEGF-A, IL-10 and TGF- β 1 were similar with both graft groups.

Conclusion: There are clear differences in the biomolecular activity in an ungrafted full-thickness, and grafted wounds. The modulation of the normal wound healing trajectory is yet to be determined. Identification of wound bed biomarkers that can predict healing is essential for design of novel treatment options and/or the development of a more efficacious synthetic or bioengineered dermal substitutes.

Predictors of in-hospital mortality and embolic complications from infective endocarditis: a 3-year retrospective cohort study

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Background and Aims

We sought to investigate predictors of in-hospital mortality and embolic complications from infective endocarditis amongst patients admitted at The Alfred

Methods

Patients admitted at The Alfred between July 1 2017 and June 30 2020 with a diagnosis of Infectious Endocarditis in their discharge summary had their medical records reviewed.

Demographic data, peri-operative and intensive care unit (ICU) admission details, pre-operative echocardiogram data, and complication rates were recorded. Embolic complications including stroke, septic pulmonary embolus, splenic and/or renal embolus, limb embolus and non-aortic root abscess were identified. Logistic regression analysis was performed to determine the predictors of (i) in-hospital mortality and (ii) suffering one or more embolic complication. Univariable factors with $p < 0.10$ were included in multivariate analysis.

Results

172 patients were identified in the study, with a median age of 55 years. 114 (63%) were male. 98 (57%) patients had at least one embolic complication. 25 (15%) patients died. Age ($p < 0.03$), Atrial Fibrillation ($p < 0.047$), Diabetes Mellitus ($p < 0.007$), Stroke ($p < 0.010$), Signs of Limb Embolus ($p < 0.002$), with referral to Vascular Surgery ($p < 0.007$), Acute Myocardial Infarction ($p < 0.017$), Severe Left Ventricular Ejection Fraction (LVEF) impairment ($p < 0.015$), and the presence of multiple embolic complications ($p < 0.013$) were univariable predictors of in-hospital mortality. Age, Signs of Limb Embolus, and Severe LVEF impairment remained significant on multivariate analysis. Intravenous drug use ($p < 0.010$), S.Aureus Bacteraemia ($p < 0.000$), and large vegetation on echocardiogram ($p < 0.001$) were all univariable predictors of embolic complication.

Conclusions

Signs of limb embolus are an independent predictor of in-hospital mortality from Infectious Endocarditis. Patients with S.Aureus Bacteraemia and large vegetations on echocardiogram are at increased risk of suffering an embolic complication, and may warrant further targeted investigations.

Outcomes of sleeve gastrectomy as a revisional procedure

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Background and Aim

Given that obesity is a complex chronic disease, it is unlikely that a single bariatric procedure will durably treat a patient throughout their life. Reflecting this, nearly 20% of bariatric procedures are now revisional, the majority being sleeve gastrectomy.

Despite the prevalence of revisional surgery there is limited understanding how outcomes compare to primary operations. Questions also surround peri-operative safety and long-term risks of revisional procedures. This study aimed to address these questions.

Methods

We performed a retrospective cohort analysis of sequential patients who underwent sleeve gastrectomy after previous gastric banding.

Data were obtained from a prospectively maintained local database and were cross-checked against hospital records and The National Bariatric Surgery Registry for completeness.

Results

620 patients who underwent a revisional sleeve gastrectomy performed between 2006 and 2019. 87% of patients were female and median age was 48.

Follow-up was achieved in 94% of patients at one year, 82% at five years and 49% at ten years.

Mean BMI on day of surgery was 44kg/m² (range 27-101kg/m²). 53 patients had a single-stage conversion. Mean total body weight loss at five-years was 22% and 25% at ten years. 4% of patients gained weight during follow-up.

There were three peri-operative deaths (0.5%) and 54 patients experienced a complication. Staple line leak was reported in 3% of patients. 26 patients (4%) underwent further bariatric procedures.

Conclusion

Revisional sleeve gastrectomy can achieve both good weight loss and long-term follow-up; although the weight loss seen is lower than reported in primary series. Peri-operative risks are higher than in primary surgery.

These data confirm that further studies are required to better understand how revisional surgery may be tailored to individual patients.

Colorectal cancer disease patterns and outcomes in young adults within Australia and new Zealand, a retrospective cohort study

Presenter: Nick Johnson

Structured Abstract

Introduction

Colorectal cancer is one of the most diagnosed cancers in Australia, and increasing in incidence. International studies have demonstrated an increasing rate of colorectal cancer amongst younger patients. We sought to identify characteristics and associated outcomes amongst younger patients diagnosed with colorectal cancer compared to other age groups, in Australia and New Zealand.

Methods

We performed a retrospective study using data from the colorectal cancer audit database of Australia and New Zealand. We included all consecutive cases between 2007 to 2019, with documented follow-up. Patients were stratified into 3 age groups; those aged 18-49 years (young adults), 50-69 (middle-aged patients), and 70 years and above (elderly patients).

Results

6874 patients were included for analysis. Young adults had higher rates of T4, nodal positive and metastatic disease at time of diagnosis ($p < 0.01$). Younger patients had increased rate of development of distant metastasis (7.2% vs 7.1% vs 5.6% $p < 0.01$). Younger patients were more likely to receive adjuvant chemotherapy (59.3% vs 45.9% vs 23.8% $p = 0.01$), and surgical management of metastatic disease (46.7% vs 24.9% vs 19.6% $p = 0.01$). Kaplan-Meier analysis demonstrated that despite younger patients having equivalent or better 5-year cumulative survival with stage 1-3 disease, survival was significantly worse in those with stage 4 disease. On multivariate analysis, factors affecting 5-year overall survival were T3/4 disease, and presence of distant metastatic disease at time of diagnosis.

Conclusion

We demonstrated that younger patients had more advanced disease at the time of diagnosis, which was associated with a worse cumulative survival than middle-aged patients. A greater focus and awareness of this disease in younger patients, specifically with early identification and management is required to improve outcomes.

Patient Reported Experience on Consenting for Surgery – Elective versus Emergency

Patients

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Background and Aims. Informed consent for surgery is a medical and legal requirement, but satisfying these does not necessarily translate to high patient satisfaction. This patient-reported experience study aimed to examine the surgical consent process, comparing the patients' experience in elective and emergency settings.

Methods. Over a six-month period, post-operative patients at The Alfred Hospital's Breast and Endocrine Surgical Unit were invited to participate in a survey on the surgical consent process – including perceived priorities, information provided and overall experience. Standard statistical techniques were used, with a significant p-value of < 0.05.

Results. A total of 412 patients were invited, with 130 (32 %) responses. More patients underwent elective surgery (N= 90, 69 %) than emergency surgery (N = 40, 31 %). Emergency patients were more likely to sign the consent form regardless of its contents (93 % vs. 39 %, p < 0.001) and more likely to feel influenced by external pressures (63 % vs. 1 %, p < 0.001). Elective patients were more likely to want to discuss their surgery with a

senior surgeon (74 % vs. 23 %, $p < 0.001$) and more likely to seek advice from external sources (83 % vs. 10 %, $p < 0.001$). Both groups highly valued the opportunity to ask questions (67 % vs. 63 %, $p = 0.65$).

Conclusions. This study shows patients have a range of different priorities in preparation for surgery. Therefore, each consent process should be patient-specific, and focus on providing the patient with quality resources that inform decision-making.

Challenges in diagnosis and management of a spiradenocarcinoma:
A comprehensive literature review and case report

Presented by Katy Wagner

Background

Spiradenocarcinoma is a rare skin adnexal neoplasm that may behave aggressively. It is often associated with a benign slow growing spiradenoma that has undergone malignant transformation. Given the rarity of this neoplasm, there is a lack of consensus on treatment.

Methods

The terms “malignant spiradenoma” or “spiradenocarcinoma” were systematically used to search the PubMed, MEDLINE and Google Scholar databases. A total of 182 cases of spiradenocarcinoma were identified as eligible for this comprehensive literature review.

Results

A 64-year-old male presented the General Surgery Outpatient clinic with a 3.2x3x2.8cm chest wall high-grade spiradenocarcinoma in association with a benign spiradenoma. A local excision of the tumour under general anaesthetic was performed. Operative histology revealed the diagnosis and demonstrated that the closest margin was 1mm; therefore, a further wide local excision was undertaken. Histology confirmed no further malignancy. The patient recovered well and has had no evidence of tumour recurrence.

A subsequent review of the literature demonstrated that spiradenocarcinoma was commoner in older age and Caucasian race. In most cases, surgical excision for local disease is the mainstay of treatment with adequate margins to avoid tumour recurrence. Lymph node dissection is usually reserved for those with suspected or confirmed lymph node metastases. High rates of recurrence (20.8%), metastasis (37.4%) and mortality (19.1%) were identified.

Title:

Long term immune function following splenic artery embolisation for blunt abdominal trauma: the IMMUNE study.

Presented by Matthew Lukies

ABSTRACT**Background and Aims**

Given the rise in non-operative management of splenic laceration, the aim of this study was to quantify long-term splenic immune function post splenic artery embolisation for blunt trauma.

Methods

Quantitative splenic immune function was assessed in a previous study at this institution at a median of 6.5 months after embolisation. These patients were invited for longer-term follow-up at a median of 102 months (8.5 years) after embolisation. The median splenic injury grade was American Association for the Surgery of Trauma (AAST) 4. IgM memory B cell levels (percentage of lymphocytes and percentage of B cells) and splenic volume were assessed.

Results

Of the 49 patients who were evaluated previously, 9 patients agreed to return for long-term follow-up. One patient was excluded due to unrelated chronic immune disease. Seven cases were proximal embolisation, with one distal embolisation. IgM memory B cell levels were normal for all patients at long-term follow-up, with significant increases in proportions of IgM memory B Cells compared to previous early follow-up; $p=0.02$. One patient with low IgM memory B cell levels at short-term had normalised levels at long-term follow up.

Splenic volume trended downwards over time ($p=0.05$), however splenic volume does not correlate with function.

Conclusions

The IMMUNE study quantitatively showed a significant increase in the long-term splenic immune function following embolisation for blunt abdominal trauma when compared to short-term. Therefore, splenic artery embolisation should not be dissuaded by concerns about longer-term immune function, as patients in our cohort quantitatively remained or returned to normal. This data will help guide clinical decision making and rationalise future use of antibiotic prophylaxis and vaccination in patients post embolisation.

HYPOCALCEMIA IN SHOCKED TRAUMA PATIENTS: A SYSTEMATIC REVIEW

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Abstract

Background: During hemorrhagic shock and subsequent resuscitation, pathways reliant upon calcium such as platelet function, intrinsic and extrinsic hemostasis, and cardiac contractility are disrupted. The objective of this systematic review was to examine current literature for associations between pre-transfusion, admission ionized hypocalcemia and composite outcomes including mortality, blood transfusion requirements and coagulopathy in adult trauma patients.

Methods: This review was reported utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. We searched Ovid MEDLINE and grey literature from database inception till 3rd May 2020. Case series and reports were excluded. Reference lists of appraised studies were also screened for articles that the above-mentioned databases might not have captured. The Newcastle-Ottawa Scale was used to assess study quality.

Results: A total of 585 abstracts were screened through database searching and alternative sources. 6 unique full text studies were reviewed, of which 3 were excluded. Admission ionized hypocalcemia was present in up to 56.2% of the population in studies included in this review. Admission ionized hypocalcemia was also associated with increased mortality in all 3 studies, with increased blood transfusion requirements in 2 studies, and with coagulopathy in 1 study.

Conclusions: Hypocalcemia is a common finding in shocked trauma patients. Whilst an association between admission ionized hypocalcemia and mortality, blood transfusion requirements and coagulopathy has been identified, further prospective trials are essential to corroborating this association.

Level of Evidence: III Systematic Review.

Registration Number (PROSPERO): CRD42020105135.

Keywords: Hypocalcemia, Hemorrhagic Shock, Mortality, Coagulopathy, Transfusion

NON-OPERATIVE MANAGEMENT FOR SMALL BOWEL OBSTRUCTION IN A VIRGIN ABDOMEN: A SYSTEMATIC REVIEW

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Background and Aims:

Small bowel obstruction (SBO) is a common general surgical presentation and there has been a shift towards non-operative management (NOM) for patients with previous abdominal surgery. Historically, exploratory surgery has been mandated for SBO in patients with a virgin abdomen. However, there is increasing evidence for NOM in this group of patients.

Methods:

A systematic review was performed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A search was undertaken between 1995-2020 on Ovid MEDLINE, EMBASE and PubMed. Primary outcome measures were success and failure rates, whereas secondary outcome measures were morbidity, mortality rates and identifying underlying etiologies.

Results:

Six observational studies were included, with 205 patients in the NOM and 211 patients in the operative group. There was a high success rate of 95.6% and low morbidity rate of 3.1% in the NOM group compared to 88.6% and 26% in the operative group respectively. Both groups reported no mortalities. The most common etiologies for SBO in a virgin abdomen were adhesions (63%), malignancy (11%), foreign body/bezoar (5%), internal hernia (4%) and volvulus (4%).

Conclusion:

NOM for SBO is a safe and feasible option for a select group of clinically stable patients with a virgin abdomen without features of closed loop obstruction. Adhesions are the most common cause of SBO in this group of patients. Further large scale prospective clinical studies with standardized NOM modality, homogenous clinical resolution indicators and long-term follow-up data are warranted to allow for quantitative analysis to reinforce this evidence.

Long-term outcomes of sleeve gastrectomy

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Background:

Primary laparoscopic sleeve gastrectomy (LSG) has emerged as the most commonly performed bariatric operation across the world. The rapid uptake of LSG has preceded complete understanding of the long-term outcomes from this procedure. Initial reports of long-term outcomes have suggested high rates of weight regain, reflux and re-operation. Developments in surgical technique and attention to follow-up may result in improved outcomes, although comprehensive data are lacking.

Objective:

To determine both short and long-term outcomes following primary LSG from a single bariatric unit.

Methods

Analysis of prospectively maintained databases for 2489 patients who underwent primary LSG between 2006 and 2019 by surgeons in our department. Data cross linkages with The National Bariatric Surgery Registry were performed to identify: outcome domains, demographics, complications and follow up.

Results

There were 2489 primary LSG performed. Patients were mostly female (79%), had a mean age of 41 ± 10 and a mean baseline BMI of 45 ± 8 ($126 \text{ kg} \pm 27$). Mean length of stay was two nights.

Maximal weight loss was achieved at two year follow up (%TWL 34 ± 14). Long term follow-up (mean 8 years) demonstrated an average %TWL of 29 ± 12 .

77 patients (3.1%) experienced a complication, 30 (1.2%) greater than Clavien-Dindo Grade III. There were 30 sleeve leaks (1.2%). Other perioperative complications were classified as: bleeding (0.4%), sepsis (0.3%), venous thrombosis (0.4%), wound problems (0.9%), fistula formation (0.2%), other organ system dysfunction (0.8%). Long term reflux and stricture rates were also recorded. There were six deaths (0.2%) during follow-up, but none occurred in the peri-operative period.

18 patients (0.7%) underwent a second bariatric operation, on average 2 years after primary LSG.

Conclusions

We have comprehensively analysed outcomes of primary LSG utilising data cross linkage. Our results demonstrate high follow up rates, sustained long term weight loss and a low rate of re-intervention and a low rate of complications.

Title: Burn wound excision within 24 hours in Australia and New Zealand: A 9-year review

Authors:

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Background and Aims

Severe burns are accompanied by an acute hypermetabolic response typified by elevated levels of proinflammatory cytokines and acute-phase proteins. When persistent, this inflammatory response can result in multi-organ dysfunction and death. Regarded as the standard of care, early excision of devitalised tissue mitigates this hypermetabolic response. Ascertaining the optimal time point for early excision, which remains controversial, has several clinical implications. This study aimed to compare variations in the timing of initial burn wound excision across Australian and New Zealand burn centres and to identify potential outcome differences when excision was performed within 24 hours.

Methods

This retrospective observational study included 836 adult thermal burns patients with total burned surface area $\geq 20\%$ from all Burns Registry of Australia and New Zealand (BRANZ) Hospital sites, including the Victorian Adult Burns Service, from July 1 2009 to June 30 2018. Patients were divided into two groups, “early” and “delayed”, based on a 24-hour excision cut-off from when injury occurred. Outcome measurements included mortality, hospital length of stay, ICU length of stay, ventilation requirements and the incidence of positive blood cultures.

Results

Among all patients at BRANZ sites, excision within 24 hours was associated with reduced mean length of ICU stay (6.6 ± 8.1 vs. 9.2 ± 10.6 days; $p=0.008$) and lower mean ventilation requirements (94.9 ± 160.8 vs. 159.2 ± 219.1 hours; $p=0.001$) in the 20-29% TBSA sub-group. Beyond this, no significant differences were observed in outcome measurements.

Conclusions

While it is physiologically important to perform early burn wound excision to mitigate the inflammatory response, delaying excision beyond 24 hours for surgical planning, possibly up to 72 hours after injury, may be a reasonable approach for certain patient groups.

Title: A COVID-19 pandemic consciousness: Aerosolization and droplet contamination mapping during pleural decompression and its hazards to the surgeon.

Authors' full names and qualifications:

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Abstract word length: 275 words

Background

In response to the COVID-19 pandemic, it is argued that pleural decompression (PD) is an aerosol generating procedure and that personal protective equipment (PPE) provides adequate protection to the proceduralist.

Primary Aim: Investigate viral droplet contamination (DC) during PD and intercostal catheter (ICC) insertion.

Secondary Aim: Assess barrier protection adequacy of recommended PPE and to elucidate hazards to the surgeon.

Methods

We constructed a model using the Limbs&Things™ Chest Decompression Trainer to simulate a tension haemopneumothorax. The manikin is an anatomically accurate representation of the torso that includes bony, soft tissue landmarks and internal anatomy. The manikin's hemithoraces were filled with ~1000ml of red-dyed water, 2ml of 100mg/mL fluorescein and ~500ml of air. The proceduralist wore the recommended PPE: visor, cap, surgical gown, gloves and an N95 mask. An open technique was employed to perform PD and insert an ICC. The procedure was filmed and photographed under normal and blue light to assess fluorescent marker contamination.

Results

Slow motion video review revealed DC of the surgeons' upper limbs, trunk and facial visor during the procedure. Post-procedure, areas of red fluid were visible on both gloves, the dominant forearm and the gown's waist. There was no visible contamination to the head, neck or chest under normal lighting. However, under blue light, fluorescein DC was visible extending onto the visor, shoulders and chest.

Conclusion

Our simulation demonstrates that DC to the proceduralist occurs during PD and the PPE described appeared to provide adequate barrier protection. It's highly plausible that aerosolization occurs, though this is not visible to the naked eye. There appears to be no other studies to date reporting on the evidence of this subject.