

ACADEMIC: ABSTRACTS

The University of Auckland BMedSc(Hons) abstracts

Does the addition of biochemical markers improve the performance of cardiovascular risk prediction equations derived from administrative health datasets?

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Background

Risk prediction equations are an established tool to inform clinical decisions regarding cardiovascular disease (CVD) prevention. Novel equations derived from the limited set of predictors available in administrative health databases have been used in several countries to predict CVD cases across entire populations, informing population-based CVD prevention efforts. In Aotearoa New Zealand, the availability of a large regional database containing all hospital and community laboratory results provided an opportunity to determine whether the addition of biochemical markers would improve the performance of current administrative data-based CVD risk prediction equations.

Materials and Methods

Estimated glomerular filtration rate, haemoglobin A1c, total cholesterol/high-density lipoprotein cholesterol ratio, and triglyceride tests performed between 31 December 2008 and 31 December 2015 in northern New Zealand were extracted (11,031,814 tests across 805,509 people) and linked to previously developed “health administrative data-based” cohorts. Sex-specific Cox models estimating 5-year CVD event rates in people aged 30- to 74-year-old without prior CVD were developed and internally validated utilising and excluding these new predictors.

Results

516,483 individuals (64% of the total cohort) had complete test result data, of whom 2.5% of women and 4.5% of men experienced a CVD event in 4.8 years mean follow-up. All four biochemical tests were statistically significant predictors, and models including these additional predictors displayed improved discrimination and calibration in the whole cohort and most examined sub-populations.

Conclusions

These results highlight that laboratory tests are powerful additions to administrative data-based CVD risk prediction equations, and further support the efficacy of population-level risk prediction as an equity-enhancing public health tool.

The impact on the use of plastic consumables in Volatile Anaesthesia vs. Total Intravenous Anaesthesia

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Background

The effects of climate change are increasing and detrimental to global health. It is vital for us to understand healthcare's emission activity to make informed choices and improve sustainability. Current evidence favours using total intravenous anaesthesia (TIVA) over inhalational agents due to greenhouse gas emissions. On the other hand, TIVA leads to a great generation of plastic waste, which has not been directly investigated before. The study aims to quantify anaesthetic plastic use in theatres to accurately evaluate this trade-off and produce a more detailed comparison between the two techniques.

The result shall bring attention to the broader ecological dynamics of our practice and encourage means of mitigating this compensation for future improvements.

Materials and Methods

A questionnaire form was developed for recruited anaesthetists to record individual plastic consumables during operations. Data were analysed and compared with independent variables such as anaesthetic agents used, patient and surgical complexity.

Results

The time and syringe reuse adjusted results shows that TIVA cases use 31.7 grams of plastic per hour more than volatile anaesthesia cases. The corresponding carbon emission from this plastic use is still far less than all values of volatile agents' one minimum alveolar concentration hour equivalent.

Conclusions

TIVA increases plastic consumption compared to volatile anaesthesia, but the increase in equivalent carbon emission from TIVA plastic does not override the benefit of avoiding volatile anaesthesia.

Effect of high fresh gas flow rate and heat moisture exchanger on inhaled gas humidity: A bench-top study

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Background

The contemporary advice to use total intravenous anaesthesia over inhalational anaesthetics for environmental concerns removes the need to practice minimal flow anaesthesia to limit greenhouse gas release. Evidence has suggested that running high flow may be economically advantageous for preserving carbon dioxide absorbent. Fresh gas flow rates above 6L/min and the effect on inhaled gas humidification have not been investigated. This study examines the impact of a wide range of fresh gas flow (FGF) and heat moisture exchangers (HME) on inhaled gas absolute humidity and circuit efficiency.

Materials and Methods

A bench-top test rig was developed to mimic the human respiratory condition with an artificial lung and humidifier. The test rig was connected to a conventional anaesthetic machine with a carbon dioxide scrubber, and inhaled gas humidity absolute was measured under different conditions over time.

Results

The average humidity measured for circuits without HME was above the minimum requirement of 20mg/L H₂O up to 2L/min fresh gas flow, and humidity was consistently around 30mg/L H₂O for all flow rates up to 10L/min. An exponential decrease in circuit efficiency and humidity was observed. For flow rates of 0.5, 4 and 10L/min, circuits without HME had average efficiencies of 65.6%, 32.2% and 16.9%, and those with HME had average efficiencies of 93.7%, 84.3% and 75.8% respectively.

Conclusions

With the combination of the investigated anaesthetic machine, HME and CO₂ scrubber used, the breathing circuit running without an HME can deliver sufficient humidity for short mechanical ventilation of up to 2L/min. On the other hand, the humidity measured is more than adequate for circuits with HME regardless of FGF.

Effect of heat-moisture exchanger and fresh gas flow rates on inhaled gas humidity in adult patients during general anaesthesia: A systematic review and meta-analysis of randomised controlled trials

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Background

In anaesthetic breathing circuits for patients going under general anaesthesia, different fresh gas flows (FGF) and the use of a heat-moisture exchanger (HME) can impact inhaled gas absolute humidity (IGAH). The recommendations for minimum IGAH to avoid respiratory complications are 20mgH₂O/L for short-term ventilation and 30mgH₂O/L for long term. We aim to provide an updated evaluation of the effect of HME and FGFs to supplement current evidence.

Methods

A systemic review of randomized controlled trials with meta-analysis. Subgroup analysis was completed based on defining minimal FGF as

<0.5 L/min, low FGF as <2.0 and high FGF as >2.0. Data points were extracted for 30, 60, 90 and 120 minutes. Mean differences and 95% confidence intervals were used to express effect sizes.

Results

Ten studies were included in the analysis. The IGAH was higher in minimal flow compared to low flow at 60, 90 and 120 minutes, but not 30. The low flow group had higher IGAH at all time points compared to high flow. A stable minimum humidity of 20mgH₂O/L was achieved for minimal flow without an HME, but not for low or high flows. Applying an HME within the breathing circuit increased IGAH for all three flow rates across time points. IGAHs attained were mainly around 30 mgH₂O/L regardless of flow rates and time when using an HME.

Conclusions

Intubated patients undergoing mechanical ventilation should receive an HME for low and high flow, but it is not required for minimal flow to achieve target humidity.

Growth differentiation factor-15 in patients recovering from acute coronary syndromes

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Background

Plasma concentrations of growth differentiation factor-15 (GDF-15) are known to be prognostic in patients with acute coronary syndromes (ACS). However, the pattern of GDF-15 in the months post-ACS remains uncertain. This study aimed to investigate the temporal pattern of circulating GDF-15 in the intermediate to long-term post-ACS.

Methods

The Biomarker-guided Risk Management following Acute Coronary Syndrome (BioMACS) clinical trial, enrolled patients between 1-12 months post-discharge after an ACS. Patients were selected from the trial's usual care arm, with equal numbers of NSTEMI and STEMI. Groups were matched by time from ACS. GDF-15 was measured at baseline and 3-months using the ROCHE Cobas assay.

Results

60 patients were included, 30% female, median age 67 years. Ethnicity was 81% European, 2% Māori, 7% Pacific, 7% Asian, 3% Indian. For the whole group, mean GDF-15 concentrations were 1430 (standard deviation (SD) 632) pg/ml at baseline, and 1348 (SD 626) pg/ml at 3-months. No significant differences in GDF-15 concentrations were found between NSTEMI and STEMI groups at both timepoints. The change from baseline to 3-months was -93 (SD 462) pg/ml, with no statistically significant difference in the change between the NSTEMI and STEMI groups. GDF-15 was related to age, systolic blood pressure, and measures of renal function (creatinine and eGFR).

Conclusions

GDF-15 concentrations were elevated in the months post-ACS but remained stable over a further 3-month period. The prognostic role of this biomarker in the convalescent period post-ACS needs to be assessed in future research studies.

Neuroimaging features for predicting post-stroke upper limb outcome

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Background

Neuroimaging biomarkers are currently underutilised for stroke motor outcome prediction. Atlas-based biomarkers, one type of neuroimaging biomarkers, distil complex neuroimaging features to clinically relevant information and may be used in stroke outcome prediction. This project aimed to identify potential atlas-based neuroimaging features for classifying stroke upper limb outcomes.

Methods

T1-weighted magnetic resonance images of 146 stroke patients with motor impairment from Auckland City Hospital were retrospectively analysed using classification and regression tree to compare voxel-atlas features derived from existing eight brain atlases. Eight individual voxel-atlas feature models and one combined voxel-atlas feature model were created. Feature importance from Gini impurity and mean model accuracies were calculated. The model prediction label was the action research arm test score at three months categorised to four classes. A qualitative analysis of four diffusion tensor images was further performed to explore the limitations of voxel-atlas features.

Results

White matter atlas features were consistently ranked highest in feature importance. The combined model mean accuracy was 0.58 ± 0.045 and no statistically significant differences in accuracy were identified between all nine models. Qualitative analyses of diffusion tensor imaging demonstrated that voxel-atlas features may not adequately capture the underlying pathophysiological processes of lesioned neuro-anatomical structures.

Conclusions

While voxel-atlas features inadequately discriminated 4-class upper limb outcomes, the study identified that white matter regions are consistently more useful for upper limb outcome prediction than grey matter regions. Further identification of atlas-based biomarkers should be explored while considering the potential limitations of voxel overlap in explaining underlying pathophysiology.

Imaging biomarkers in the progression of pancreatitis and the role of gut hormones, bile acids, and markers of lipid metabolism

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Background

Pancreatitis is increasingly viewed as a progressive disorder. Advanced magnetic resonance (MR) techniques have demonstrated precision in measuring ectopic fat phenotypes in the abdomen, which can be effective biomarkers in pancreatitis progression. Gut hormones, markers of lipid metabolism and bile acids (BAs) may also provide mechanistic insights into pathophysiological processes in pancreatitis.

Methods

MR was used to determine intra-pancreatic fat deposition (IPFD), intra-hepatic fat deposition, and skeletal muscle fat deposition in 201 study participants. Gut hormones, BAs and markers of lipid metabolism were measured through blood sampling. Linear regression analysis was used to determine associations between ectopic fat phenotypes (intra-pancreatic, intra-hepatic, and skeletal) and acute pancreatitis individuals (AP), chronic pancreatitis individuals (CP), and healthy individuals; as well as gut hormones in both fasted and post-prandial states. Associations between BAs and the variables above, in addition to markers of lipid metabolism, were also investigated.

Results

There was statistical significance found with IPFD in both the AP group and CP group relative to healthy individuals, with p-for-trend analysis being statistically significant ($p = 0.027$ in the most adjusted model). Ghrelin was significantly associated with AP individuals in the fasted state ($p = 0.019$ in the most adjusted model). BAs and high density lipoprotein-C (HDL-C) were significantly associated ($p = 0.012$ in the most adjusted model).

Conclusions

These results demonstrate intrapancreatic fat deposition to be an effective biomarker in pancreatitis progression. Ghrelin may play a role in the pathogenesis driving IPFD whilst BAs may contribute to oxidative processes and metabolic derangement with HDL-C involvement.

The effect of regional anaesthesia on patient outcomes following traumatic rib fractures: an observational study of a metropolitan Auckland patient cohort

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Background

Regional anaesthesia (RA) may be superior to other options in those with traumatic rib fractures (RF). The aim of this study was to investigate the impact of demographic, laboratory, and thoracic injury indices on RA use, and the impact of RA on patient outcomes after traumatic RF.

Methods

Patients who presented to hospital with RF were propensity matched by RA exposure to one of two groups. RA use was defined as exposure to continuous paravertebral, epidural, intercostal, erector spinae or serratus anterior plane blockade. Outcome measures were the association between RA and length of stay in hospital, mortality, admission to the critical care unit, and length of stay in these units. Propensity groups were matched on age, pre-injury lung disease, number of fractures, comorbidity, and injury scores.

Results

Those who received RA had greater Charlson Comorbidity Index scores ($p = 0.019$), a greater neutrophil/lymphocyte ratio ($p < 0.001$), a greater number of RF ($p = 0.001$), and an increased chance of having flail chest ($p = 0.0016$). Patients who received RA had an increased hospital length of stay ($p < 0.001$), a greater incidence of admission to the critical care unit ($p < 0.001$), and no difference in 30 or 90 day mortality ($p = 0.8$ and $p = 0.5$, respectively).

Conclusions

RA use is more frequent in patients who are more co-morbid, with more serious injuries. Those who received RA stayed longer in hospital and were admitted to advanced-care units more frequently. There were however no differences in mortality.

Risk factors for pulmonary morbidity and patient outcomes following traumatic rib fractures: an observational study of a metropolitan Auckland patient cohort.

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Background

Rib fractures (RF) are a significant cause of pulmonary morbidity (PM) and mortality following trauma. The aim of this study was to evaluate the effects of demographic, laboratory, and thoracic injury indices on PM in patients with RF, and subsequently how PM impacts patient outcomes.

Methods

Patients who presented to hospital with RF were assessed for PM, defined as ventilator and hospital associated pneumonia or atelectasis within 30 days of admission. Outcome measures were PM and the sequelae of that morbidity, namely hospital length of stay, 30 and 90-day mortality, and admission to the intensive care unit and/or high dependency unit including the length of stay in these units.

Results

Those who experienced PM were older ($p < 0.001$) and had a greater number of RF ($p = 0.006$). Additionally, those with PM were more likely to have pre-injury lung disease ($p = 0.021$), a radiological diagnosis of their fracture(s) ($p = 0.001$), and the presence of haemothorax ($p = 0.006$). The median length of stay in hospital was greater in those with PM ($p < 0.001$) as was the 90-day mortality ($p = 0.012$).

Conclusions

Pulmonary morbidity is more frequent in those who are older, more co-morbid, and have more serious injuries. The sequelae of thoracic trauma may be the largest contributor to patients developing PM, and those who experienced PM stayed longer in hospital and had increased mortality at 90-days.