

## 339 Traumatic Intracranial Hemorrhage in Older Patients on Direct Oral Anticoagulants



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**Study Objectives:** The objective of this study was to compare the incidence of traumatic intracranial hemorrhage (ICH) and delayed ICH in older head-injured patients taking direct oral anticoagulants (DOACs) compared to those who are not taking anticoagulants and those taking vitamin K antagonists.

**Methods:** This was a single-center, retrospective medical record review of patients, age greater than fifty-five years, taking a DOAC and presenting to a large Level-1 Trauma Center with an acute head injury who had computed tomography of the head (hCT) performed as part of routine care. The review period ran from the initial release of DOACs in October 2010 until August 2017 and was performed using key word identifiers and text recognition to identify any patient on a DOAC. All charts identified electronically as meeting inclusion criteria were then reviewed manually using a data abstraction tool to confirm use of a DOAC and to exclude any patients who had been transferred to the center for a known ICH. The incidence of acute and delayed ICH (defined as acute ICH with a negative hCT in the previous seven days) was compared between the DOAC group, a randomly selected group of head-injured patients not taking anticoagulants, and a randomly selected comparator group of patients taking vitamin K antagonists, matched for age, race, and sex. Glasgow Coma Scale (GCS) scores and use of anti-platelet drugs were also collected for analysis. We also compared rates of repeat head imaging after initial negative hCT, admission rates, and death during hospitalization between the three groups, using proportions with 95% confidence intervals (CI).

**Results:** There were a total of 249 head-injured patients on DOACs, who presented to the ED and received a hCT over the study period. During this same period, there were 10,566 head-injured patients not on anticoagulants who received a hCT, and 1189 head-injured patients on vitamin K antagonists who received a hCT who served as the matched control and comparator groups. The incidence of ICH was not significantly different between the patients on DOACs (7.2%; 95% CI 5.6-11.1%), those not taking anticoagulants (6.8%; 95% CI 4.0-10.7%), and those taking vitamin K antagonists (4.0%; 95% CI 1.9-7.3%). There were no delayed ICHs (0%; 95% CI 0-1.6% for all groups) detected in any group. Repeat head imaging after an initial negative hCT was performed in 27.3% (95% CI 21.9-33.3%) of patients on DOACs, compared to 11.2% (95% CI 7.6-15.8%) of patients not on anticoagulants, and 16.9% (95% CI 12.4-22.1%) of patients taking vitamin K antagonists. Admission rates (69%, 66%, 71%) and death during hospitalization (2.4%, 3.6%, 4.0%) were not significantly different between patients on DOACs, no anticoagulants, and vitamin K antagonists, respectively.

**Conclusion:** In older adult patients with suspected traumatic brain injury that received a hCT, the incidence of acute or delayed ICH was not significantly different between patients taking DOACs, those not taking anticoagulants, and those taking vitamin K antagonists. Repeat head imaging in patients taking DOACs with an initial negative hCT was significantly more common than in those not taking anticoagulants. Delayed ICH in head-injured patients with an initial negative hCT is a rare event, even among patients on DOACs, with none identified over an approximately eight-year study period.

## 340 Physician Heal Thyself: Suicide Rate of Physicians is Higher Than That of Law Enforcement or Military Personnel



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**Study Objectives:** Recent media focus on suicide in the military and law enforcement has created a large amount of public attention. Studies on medical residents' well being have shown us that medical professionals can be at high risk as well. We studied these high-risk occupations to better understand the scope and context of this sensitive issue.

**Methods:** We queried The National Institute on Occupational Safety and Health, National Occupational Mortality Surveillance (NOMS) database for suicide rates by occupation. NOMS is a population-based survey broken into early (1985-1998) and late (1999, 2003, 2004, 2007-2013) time periods. Mortality rates are estimated by calculating proportionate mortality ratios (PMR). A PMR of 100 represents the average suicide rate for the general population. 95% Confidence intervals were provided by the database.

**Results:** Of all occupations catalogued in NOMS, physician suicide rates were ranked amongst the top five in both time periods. Physicians suicide rates were significantly higher than the general population over both time periods and trended up over time (PMR 220 to 254). Suicide rates for physicians were higher than nurses (PMR 96), military (PMR 161) and law enforcement personnel (PMR 164) in both time periods.

**Conclusion:** Physicians have higher rates of suicide than law enforcement or military personnel. Stress and suicide rates appear to be disproportionately distributed in the medical community. More study is warranted and more attention needs to be directed towards preventative measures.

## 341 The Significance of Pulse Pressure in the Early Phase of Hemorrhagic Pathological Conditions: An Observational Study Using the Japan Trauma Data Bank



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**Study Objectives:** Early recognition of hemorrhagic shock is very important in the management of trauma patients. In the hemorrhagic shock severity classification released by the American College of Surgeons (ACS), "pulse pressure narrowing" in Class 2 hemorrhagic shocks is emphasized. However, there are few clinical studies showing its significance. Therefore, we attempted to investigate the correlation between pulse pressure narrowing and mortality in the early phase of hemorrhagic shock using Japanese nation-wide trauma registry data.

**Methods:** We used the data from about 290,000 cases collected between 2004 and 2017 in the Japan Trauma Data Bank (JTDB), Japanese nation-wide trauma registry data. We extracted the data of all patients age 16 or over who met all of the following conditions at their time of arrival: heart rate 50 ~ 120 bpm, systolic blood pressure 110mmHg or above, respiratory rate 14 ~ 30 breaths per minute, and GCS 14 or above. We conducted a multiple logistic regression analysis for all of the abovementioned patients who fall under Class 1 and 2 of the ACS classification, with death as the objective variable and age, sex, various vital signs, etc. as the explanatory variables.

**Results:** There were 107,472 subject patient cases and the overall mortality rate was 1.49%. The mortality rate was 1.31% for Class 1 patients and 2.63% for Class 2 patients. With pulse pressure narrowing (pulse pressure/systolic blood pressure < 0.25), the adjusting odds ratio for death increased significantly, by 1.39 times (95% CI; 1.09-1.78). It increased similarly by 2.04 times (95% CI; 1.81-2.29) with tachycardia (a heart rate of 100 beats per minute or above) and 1.37 times (95% CI; 1.24-1.51) with tachypnea (a respiratory rate of 100 breaths per minute or above).

**Conclusions:** There is a possibility that risk of death may be stratified by pulse pressure narrowness in Class 1 and 2 patients in the early stage of hemorrhagic shock. In order to recognize hemorrhagic shock in its early stage, we need to observe pulse pressure along with the respiratory and heart rates. In this observational study, we were able to redefine the importance of pulse pressure.

## 342 Smartphone and Wrist-Wearable-Based Biomarkers of Pain Severity After Emergency Department Discharge: Preliminary Results From the AURORA Study



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**Study Objectives:** Adverse posttraumatic neuropsychiatric sequelae (APNS) such as posttraumatic pain cause great suffering in civilian trauma survivors and military personnel and are traditionally evaluated using self-report symptoms alone. Objective biobehavioral indicators are needed to more fully characterize posttraumatic phenotypes, gain new insights into pathophysiological mechanisms, better understand patient experiences, and improve the assessment of patient recovery. Identifying objective biobehavioral indicators of APNS is a goal of the ongoing AURORA study, a

~40 million-dollar effort funded by NIH, the DoD, and foundation and industry partners.

**Methods:** AURORA performs serial assessments of neurocognitive, physiologic, digital phenotype, psychophysical, neuroimaging, and genomic domains in thousands of individuals who present to the ED after trauma exposure. The present analysis performed initial screening for state biomarkers of pain severity during the first eight weeks after trauma in an initial study sample (=867). Pain severity was assessed using latent variables developed from self-report questions administered via the Mindstrong smartphone App at six timepoints during the first eight weeks after trauma. State biomarkers were screened from two domains: heart rate variability (HRV) data were obtained from the Verily Study Watch, provided to all participants at the time of ED discharge, and activity metrics derived from the Mindstrong app. Associations between changes in pain severity and changes in candidate state biomarkers over time were assessed using Pearson correlation.

**Results:** In screening analyses, a number of promising state biomarkers of pain severity were identified from both HRV and activity domains. Promising state biomarkers included measures of heart rate variability (eg, elevations in high frequency power,  $p < .04$ ), reduced sympathovagal balance ( $p < .0056$ ) and measures of within-subject activity (time spent at home,  $p < .0087$ ), distance traveled during day ( $p < .004$ ), farthest distance traveled from home ( $p < .0024$ ), time spent in the most frequent location during the day ( $p < .0088$ ) and during the weekends ( $p < .0103$ ).

**Conclusion:** These preliminary analyses suggest that state biomarkers of APNS outcomes such as pain can be identified. The results of further derivation analysis within a larger subsample will be presented at the conference.

## 343 Extending the Golden Hour: Intermittent Versus Partial REBOA for Prolonged Hemorrhage Control



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**Study Objectives:** Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a developing technology to stabilize patients with non-compressible torso hemorrhage. The therapeutic duration of REBOA is limited to 30 minutes due to the profound ischemia distal to the point of occlusion. Partial-REBOA (pREBOA), where small amounts of distal flow are allowed past the balloon, and intermittent-REBOA (iREBOA), where the balloon catheter is fully deflated intermittently to allow distal flow, are techniques proposed to extend the therapeutic duration of REBOA. We hypothesized that pREBOA would reduce blood losses and ischemic burden when compared to iREBOA in a large animal model of hemorrhagic shock requiring 90 minutes of REBOA intervention.

**Methods:** Ten pigs were anesthetized and instrumented. Following 20% blood volume hemorrhage, animals underwent uncontrolled hemorrhage from the right iliac artery and vein. After reaching a mean arterial pressure (MAP) of 40 mmHg, animals underwent 15 minutes of complete Zone 1 REBOA followed by 75 minutes of either pREBOA or iREBOA (N=5/group). In the pREBOA group, the balloon was deflated until the MAP below the balloon increased by 7-10 mmHg. In the iREBOA group, the balloon was fully deflated after complete occlusion until a low MAP goal was met, then fully inflated for 10 minutes before re-attempting deflation. In both groups, if the MAP fell below 40mmHg, the aorta was fully occluded for 10 minutes and animals received a blood transfusion (limited to three transfusions). After 90 minutes, definitive hemorrhage control was obtained, and animals were resuscitated with the remaining blood followed by 2 hours of critical care.

**Results:** There were no differences in survival until the end of the study between the two groups (3/5). All animals in the iREBOA group received 3 blood boluses (IQR 3-3) during the intervention while animals in the pREBOA group required 2 blood boluses (IQR 2-3,  $p=0.05$ ). Animals randomized to iREBOA spent a larger portion of time at full occlusion when compared to pREBOA (mean $\pm$ standard deviation:  $74.0\pm5.5\%$  versus  $30.0\pm20.0\%$ , respectively;  $p<0.01$ ). There were no differences in blood loss or final plasma lactate concentrations.

**Conclusion:** pREBOA reduced time spent at full occlusion and blood product requirements but does not provide a survival benefit. Further research is required into both of these techniques to extend the therapeutic duration of REBOA.

## 344 DIY AI: Deep Learning Algorithm for Ultrasound Video Analyses and Classification



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**Background:** Artificial intelligence (AI) is increasingly a part of daily life and offers great possibilities to enrich health care. Imaging applications of AI have been mostly developed by large, well-funded companies and currently are inaccessible to the comparatively small market of point-of-care ultrasound (POCUS) programs.

**Study Objectives:** Given this absence of commercial solutions, we sought to devise and test a do-it-yourself deep learning algorithm to classify ultrasound (US) images to enhance the quality assurance workflow for POCUS programs.

**Methods:** We created a convolutional neural network (CNN) utilizing publicly available software tools and preexisting CNN architecture. The CNN was subsequently trained using US images from 7 US exam types: pelvis, heart, lung, abdomen, musculoskeletal (MSK), ocular and central venous access from 149 publicly available POCUS videos. A total of 125,000 individual images were extracted from the videos, 80% were used for model training and 10% each for cross validation and testing, to simulate POCUS program workflow. To simulate algorithm transfer to a different POCUS program, we tested the algorithm for accuracy against a set of 160 randomly extracted US frames from US videos not previously utilized for training and which were performed on different US equipment. Three POCUS experts blindly categorized the 160 random images and results were compared to the CNN algorithm. Descriptive statistic and Krippendorff agreement correlation were then calculated.

**Results:** The cross validation of the CNN approached 99% for accuracy during training. The algorithm accurately classified 98% of the test US images. In the new POCUS program simulation phase, the algorithm accurately classified 70% of 160 new images for good correlation with the ground truth,  $K = 0.64$ . The 3 blinded POCUS experts correctly classified 93, 94 and 98% of the images, respectively. There was excellent agreement among the experts with  $K = 0.87$ . Agreement between experts and algorithm was good with  $K = 0.74$ . The most common error was misclassifying MSK images for both the algorithm (40%) and POCUS experts (40.6%). The algorithm took 7 min 45 seconds to review and classify the new 160 images. The 3 expert reviewers took 27, 32 and 45 minutes to classify the images, respectively.

**Conclusion:** Our algorithm accurately classified 98% of new images related to its training pool, simulating POCUS program workflow. Performance was diminished with exam images from an unrelated image pool and US equipment, suggesting additional images and CNN training are necessary when using across different POCUS programs. In addition to improving workflow for POCUS administrators, the implications of our do-it-yourself AI for POCUS are scalable and further work to maximize the collaboration between AI and POCUS programs is warranted.

## 345 Carotid Ultrasound for Fluid Responsiveness: A Systematic Review



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**Study Objectives:** The aim of this paper is to perform a systematic review of the accuracy of carotid ultrasound in relation to volume status in adults.

**Methods:** We searched OVID Medline and SCOPUS databases from conception to January 1, 2019 for terms of "carotid" and "ultrasonography" using both MeSH and keyword terms. Titles and abstracts from these search methods were screened independently by 2 physicians (LB, JD). If either physician thought an article was potentially relevant, a full text copy of the article was ordered and again reviewed for inclusion by these 2 authors. Inclusion criteria were peer-reviewed studies that evaluated human adult patients with a measurement of carotid ultrasonography in response to a hemodynamic change. Exclusion criteria included abstracts, non-English papers, studies on children or pregnant women, or studies with not enough data to address the research question. After title and abstract selection, a standardized abstraction form was developed by all of the authors. Two authors (LB, JD) abstracted data from the studies and compared their results for discrepancies. These were resolved by consensus among all three authors. Quality of included studies was assessed using QUADAS-2. Two authors (LB and JD) assessed quality and risk of bias using this tool and agreed upon a final quality score for each study.

**Results:** Four hundred sixty-five articles were identified. Eighteen articles with 1010 patients were deemed to meet inclusion (Figure 1). The most commonly used carotid measure was corrected flow time (FTc) (10/18, 56%). Other measures included