

Oral Presentations - On-line Meeting Collaboration in Surgery

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Committed to Indigenous health
RACS acknowledges the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters and community.
We pay our respects to them and their cultures and to Elders both past and present.

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MACHINE LEARNING ALGORITHMS FOR PREDICTING AND RISK-PROFILING CARDIAC SURGERY-ASSOCIATED ACUTE KIDNEY INJURY

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Monash

Biography:

Junior doctor, surgical registrar at Barwon Health, and PhD candidate

Objective(s) Using a large national database of all common cardiac surgeries recording demographic, physiologic, and biochemical parameters, we aimed to apply machine learning (ML) to improve risk stratification for cardiac surgery-associated acute kidney injury (CSA-AKI), and compare their performance to the pre-existing standard of clinical scoring tools.

Methods Eight ML algorithms were used, including logistic regression (LR), decision trees (DT), random forest (RF), gradient boosted machine (GBM), K-nearest neighbour (KNN), support vector machine (SVM), neural networks (NN), and a triplet network autoencoder (AE). These were compared to the Cleveland Clinic score, and a previously published risk score developed on the same database. Five-fold cross-validation repeated four times was used to assess performance of ML algorithms. Metrics measuring performance were the area under the receiver operating characteristic curve (AUC), the Brier score, sensitivity, and specificity.

Results A total of 85360 cardiac surgery events in 84080 unique patients were used for analysis. For the outcome of new postoperative renal replacement therapy, LR, GBM, and SVM outperformed the risk scoring tools whereby each achieved an AUC of 0.90 (0.89-0.90). For predicting CSA-AKI, LR, GBM, and SVM outperformed the scores whereby each achieved an AUC of 0.81 (0.80-0.82).

Conclusion ML algorithms provide a state-of-the-art approach to risk stratification that can leverage large national datasets. Further work needs to be performed to create explanatory modelling to aid the clinician in understanding the complex decision boundaries these algorithms can learn and provide more personalised and actionable risk stratification profiles.

PANCREATICODUODENECTOMY - OUTCOMES OVER A 8 YEAR PERIOD IN A REGIONAL SPECIALISED HEPATOBILIARY SERVICE

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Launceston General Hospital

Biography:

Ashraf Tokhi is a current SET 4 Trainee in Victoria, with an interest in regional subspecialised surgery.

Background Pancreaticoduodenectomy, a procedure performed for tumours of the head of pancreas, is a specialised procedure that requires multidisciplinary care, often only available in specialised centres. Our centre in Tasmania provides a unique situation with a regional centre isolated from the mainland, with a population spread throughout the island.

Our aim is to ascertain whether the standard of care in regional Tasmania meets the expected performance in comparison to expected levels. A retrospective cohort study was performed, to determine rate of complications and mortality rate for Whipple's procedure in a regional centre, and assess whether this procedure is safely performed in a regional centre in Australia.

Methods A complete retrospective review of collected from our General Surgical Database was performed for all patients who underwent a Pancreaticoduodenectomy between 1 January 2011 and 30 June 2019.

Outcomes 46 procedures were performed over this period. The 30 and 90 day mortality was 2.2% and 4.3%. 8 patients (17.3%) had a Clavien-Dindo 3 or greater complication. R0 resection was 85%, with a one year survival of 67.5% and five year survival of 17% for pancreatic adenocarcinoma. Two patients required transfer to other centres for further management. Overall survival was improved for patients with NO disease ($p < 0.05$). Two patients required transfer to specialist centres for further intervention.

Conclusion With appropriate services and multidisciplinary expertise, a regional centre can perform complex surgeries with outcomes equivalent to published Australian data. A relationship with central specialist centres is important to support regional centres in complex surgical procedures.

DYNAMIC INTRALUMINAL PRESSURISATIONS FOCALLY TRANSMIT EXCESS SHEAR FORCE TO THE PROXIMAL STAPLE LINE. A KEY MECHANISM MEDIATING LEAKS FOLLOWING SLEEVE GASTRECTOMY?

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The Alfred Hospital

Biography:

William is a current unaccredited general surgery registrar with an interest in Upper GI and Bariatric Surgery.

Purpose: Staple-line leaks occur predominately adjacent to the OG junction. A narrow high-pressure system is proposed to be a key driver of chronic leaks, however, objective data to support this is limited. We aimed to characterise intraluminal pressurisation in the post-operative stomach and evaluate where maximal strain is delivered.

Methodology: i) High resolution manometry was used to compare sleeve gastrectomy patients to obese controls. ii) Finite-element analysis simulated gastric pressurisation with tensile ultimate strength of 0.67MPa, strain at max stress 0.933. Geometry was based on volumetric CT of a sleeve shaped with a 34Ch bougie. **Results:** Demographics: age 40.5+/-17.7 years vs. 42.5+/-15.7(p=0.22), 90% female vs.78.5%(p=0.615), weight 122.3+/-21.0kg vs. 110.6+/-118.9(p=0.771), BMI 48+/-11.7kg/m² vs. 38.3+/-3.8(p=0.023). Peak swallow isobaric pressures were raised post sleeve 14.9+/-4.0 vs. 36.3+/-3.4mmHg(p=0.0005). There was no difference in the intragastric/mid-oesophageal (IG/MO) pressure -0.925+/-4.7 vs. -8.5+/-3.9mmHg(p=0.137). Peak end-expiratory pressure 13.34+/-9.3 vs. 10.6+/-4.9mmHg(p=0.2152) was similar, but the IG/MO ratio was reduced in sleeve patients -1.26+/-0.73 vs. -4.56+/-0.619mmHg(p=0.002). Simulations demonstrate peak stress at the proximal staple-line. Variations in diameter and size of dog-ear alter the distribution of strain forces acting on the proximal staple line. **Conclusions:** Significant high-pressure episodes occur in the sleeve during oesophageal contractions. Simulations suggest that maximal strain transmitted to the proximal stomach is dependent on the geometry. This may be a key factor in the initiation and perpetuation of sleeve leaks and potential therapeutic target.

LIMITED ACCESS TO INVESTIGATION AND MANAGEMENT OPTIONS OF CHOLEDOCHOLITHIASIS INCREASES LENGTH OF STAY IN AN AUSTRALIAN REGIONAL HOSPITAL.

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Biography:

Sandy Su is a current intern at Monash Health. She is passionate about developing further clinical and research experience in next year's surgical residency position.

Purpose: Choledocholithiasis can be managed as a single-stage approach (intra-operative) or two-stage approach (pre- or post-operative with or without intraoperative temporising management). Inability to perform magnetic resonance imaging and limited surgeon intraoperative temporisation expertise at regional centres often necessitate interhospital transfer for patients with choledocholithiasis. This study evaluates whether these factors significantly impact length of stay (LoS) in a small regional hospital.

Methodology: Retrospective data analysis was conducted in a regional hospital. From 1 July 2019 to 30 April 2020, all patients admitted under the surgical unit for diagnosed biliary pathology were included. Main data points identified include: demographic data, LoS, biochemical markers, conservative versus operative management, complications and interhospital transfer.

Results: 149 patients were admitted for management of biliary pathology, 79 of whom underwent cholecystectomy. Intraoperative cholangiography was performed in 72 patients, with 8 demonstrating a filling defect. One patient underwent biliary stenting, and the remaining 7 required inpatient transfer for ongoing management (MRCP, n=1; ERCP, n=5; no further intervention, n=1). For patients requiring transfer, average LoS prior to transfer for ERCP was 6.6 days and for MRCP was 5 days. LoS for the patient who underwent intraoperative biliary stenting was 2 days.

Conclusion: Limited access to investigations and management options for choledocholithiasis at the study site was associated with increased length of stay. Ultimately, surgeon training in intraoperative biliary stenting could prevent overuse of MRCP, prolonged hospitalisations and optimise healthcare outcomes. In suspected choledocholithiasis, it is safe to operate, stent or explore.

ASSESSMENT AND INTERPRETATION OF THE FUNCTIONAL VISION OF PATIENTS WITH LATE-STAGE RETINITIS PIGMENTOSA IMPLANTED WITH A BIONIC EYE IN THEIR EVERYDAY ENVIRONMENT

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Centre for Eye Research Australia (CERA)

Biography:

I am a final year Melbourne medical student currently studying at the Austin Hospital. I am completing my MD research project at the Centre for Eye Research Australia and I hold a Bachelor of Biomedicine degree with Honours majoring in Neuroscience for which I completed at the University of Melbourne.

Purpose/Aim: Retinitis Pigmentosa (RP) is a genetically inherited disorder characterised by the progressive loss of photoreceptors in the retina. Except for gene therapy targeting less than 2% of cases, there is no effective treatment. Retinal prostheses (“bionic eyes”) are implantable devices that electrically stimulate the inner retina and bypass dysfunctional photoreceptors. Bionic vision is not yet providing the level of vision required to see faces and hence, laboratory tests measuring visual acuity do not adequately represent device efficacy. The Australian suprachoroidal retinal prosthesis has yet to be analysed in the real-world setting and is the purpose of this study.

Methodology: The Functional Low-Vision Observer Rated Assessment[1] instrument was administered to four patients with late-stage RP over time with the device ON and OFF (clinicaltrials.gov #NCT03406416). In addition to qualitative data, the instrument required participants to complete 35 functional vision tasks across 4 domains. The ease of which patients completed a task was assessed using a four-point scale, ranging from impossible (1) to easy (4).

Results: From 20 to 68 weeks post-implantation, the average score for the ease of completing a task with the device ON was higher or equal to the device OFF for each participant. The main contribution were from tasks in the ‘Visual Orientation’ and ‘Daily Life’ domains.

Conclusion/Discussion: Patients with late-stage RP implanted with the Australian suprachoroidal retinal prosthesis demonstrated improved completion of tasks in the real-world setting for up to 68 weeks post-implantation. The device shows potential utility in everyday life.

1. Gerschat DR, Richards TP, Arditi A, da Cruz L, Dagnelie G, Dorn JD, et al. An analysis of observer-rated functional vision in patients implanted with the Argus II Retinal Prosthesis System at three years. *Clin Exp Optom.* 2016;99(3):227-32.

ASSESSMENT OF TUMOR INFILTRATING LYMPHOCYTES AND IMMUNE MICROENVIRONMENT PROVIDES PROGNOSTIC INFORMATION ABOUT OESOPHAGEAL CANCER

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Biography:

General Surgical SET Trainee with an interest in clinical translational research

Purpose: Tumour-infiltrating lymphocytes (TILs) have been shown to be prognostic in a number of solid organ tumours(1). The aim of this study was to determine whether TILs and expression of immune-cell related genes are associated with treatment response and prognosis in oesophageal cancer (OC).

Methodology: Study cohort consisted of 58 patients who had neoadjuvant chemoradiotherapy (CRT) followed by surgical resection. TILs were quantified in separate compartments (tumour/stroma/scar) where the final percentage score was determined by the area of infiltration by TILs and the denominator is the percentage area occupied by the compartment of interest¹. RNA was extracted from sections where TILs were quantified and gene expression was assessed using the Nanostring Platform based on the PanCancer Immune Profiling Panel.

Results: For patients who had low pre-treatment TIL counts, an increase in TIL count after CRT was associated with a superior progression free survival ($p < 0.01$). In complete and partial responders, high TIL infiltration (>10% of tumour/scar area) in resection specimens was independently associated with improved disease specific survival (HR 0.3; 95%CI 0.09 – 0.94; $p < 0.05$) in multivariate analysis. The presence of tertiary lymphoid structures in post-treatment samples was associated with less disease recurrence ($p = 0.01$). Genes associated with the presence of immunosuppressive M2 macrophages and neutrophils were highly expressed in post-treatment specimens.

Conclusion: Assessment of TIL infiltration and immune microenvironment in pre-treatment and post-treatment OC specimens may provide additional prognostic information. Treatment resistance in OC maybe explained by the possible presence of immunosuppressive cells in the tumour immune microenvironment.

1Mlecnik B et al. Cancer Metastasis Rev. 2011. Mar;30(10):5-12. 2Hendry S et al. Ad Anat Pathol. 2017. 24(5): 235-51.

POTENTIAL UTILITY OF CIRCULATING TUMOUR DNA IN THE MANAGEMENT OF OESOPHAGEAL CANCER

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Peter MacCallum Cancer Centre

Biography:

General Surgical SET Trainee with an interest in clinical translational research.

Purpose: Circulating tumour DNA (ctDNA) has clinical utility in monitoring treatment response and in the detection of disease recurrence in breast and colorectal cancer (1,2). The aim of this study was to explore the role of ctDNA in the management of patients with oesophageal cancer (OC).

Methodology: Blood samples and tumour biopsies were collected from 52 patients after diagnosis of OC. In patients planned for surgery, blood samples were taken before and after neoadjuvant treatment, and during the surveillance period. Blood samples were analysed for the same mutations present on pre-treatment tumour biopsy using a custom targeted amplicon-based approach to cover mutational foci across 9 of the most commonly mutated genes in OC.

Results: Somatic mutations in treatment-naïve OC tumour biopsies were detected in 45 out of 51 (88%) patients. Out of these 45 cases, 19 (42%) had detectable tumour-informed ctDNA in their plasma. The majority (79%) of patients who were ctDNA positive had either locally advanced or metastatic disease. In locally advanced nodal negative patients who were ctDNA positive, there was a trend towards inferior disease specific survival. After treatment, the emergence of new somatic mutations in serial surveillance blood samples was associated with recurrent disease ($p = 0.038$).

Conclusion: This study demonstrates that ctDNA may have clinically utility in the management of patients with OC by providing additional prognostic information. Assessment of ctDNA in post treatment blood samples may lead to the detection of early recurrent disease.

1. Dawson, S.-J. et al. Analysis of Circulating Tumor DNA to Monitor Metastatic Breast Cancer. *New Engl J Medicine* 368, 1199–1209 (2013). 2. Tie, J. et al. Circulating tumor DNA analysis detects minimal residual disease and predicts recurrence in patients with stage II colon cancer. *Sci Transl Med* 8, 346ra92-346ra92 (2016).

PATHOLOGY IN COLON CANCER, PROGNOSIS AND UPTAKE OF ADJUVANT THERAPY (PICC UP STUDY)

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Westmead Hospital

Biography:

Dr Emma Hollands holds a Doctor of Medicine from the University of Notre Dame Fremantle, and is currently employed as a General Surgery Senior Resident Medical Officer at Westmead Hospital.

Background: Multidisciplinary team (MDT) meetings are essential in the care of cancer patients. However, there is no clear consensus on which pathological features and biomarkers are important in guiding prognosis and adjuvant therapy.

Methods: The Pathology in Colon Cancer, Prognosis and Uptake of Adjuvant Therapy (PiCC UP) Australia and New Zealand questionnaire was distributed to colorectal surgeons, medical oncologists and pathologists.. The aim of this study was to understand current specialist attitudes towards pathological features in colon cancer. A 5-scale Likert score was used to assess attitudes towards 23 pathological features for prognosis and 18 features for adjuvant therapy. Data were analysed using a rating scale and graded response model in item response theory (IRT) on STATA.

Results: 164 specialists participated, with 80.5% regularly attending colorectal MDT meetings. Based on IRT modelling, key pathological features for prognosis in colon cancer were distant, lymph node and liver metastases. Other important features were tumour rupture, involved margin, radial margin, CRM, lymphovascular invasion and grade of differentiation. Tumour size location, lymph node ratio and eGFR status were considered less important. Salient features in decision making for adjuvant therapy in Stage II colon cancer were tumour rupture, lymphovascular invasion and microsatellite instability. BRAF status, tumour size, location, budding and tumour infiltrating lymphocytes were considered less important.

Conclusions: This study provides the current status on the importance of pathological features in prognostication and recommendations for adjuvant therapy in Australia and New Zealand. Results of this nationwide study should be considered in cancer MDT discussions.

ULTRASOUND SCREENING OF ABDOMINAL AORTIC ANEURYSM BY JUNIOR MEDICAL OFFICERS IN AUSTRALIAN RURAL HOSPITAL SETTING: A PILOT STUDY.

Dr. MEI PING MELODY KOO Dr. Vincent Wang Hon Chow Dr. Azim Fadzli Dr. Sara Stephensen Dr. Justin Shelton Mrs. Tracey Paterson A. Prof. George Kiroff
Whyalla Hospital and Health Services, SA

Biography:

Ruptured AAA is a surgical emergency and carries high mortality, this is particularly significant for rural Australian community with limited access to specialty surgical services. We were a group of junior doctors in Whyalla Hospital who took the initiative to examine the feasibility of AAA population screening performed by junior doctors in rural setting.

Purpose: Cost-effectiveness of Abdominal Aortic Aneurysm (AAA) ultrasound screening in the metropolitan setting has been demonstrated. Literature suggests that trained novices can reproduce abdominal aorta measurements comparable to sonographers. This study aimed to determine if, after limited training, junior doctors could perform ultrasound AAA screening reliably in a rural Australian hospital setting.

Methodology: This was a 23-day longitudinal study carried out at the Whyalla Hospital and Health services, a regional health provider in rural South Australia. Participants aged 50 years or above were recruited from the hospital inpatients and community volunteers. Three junior doctors who underwent 2-hour practical Point-of-Care ultrasound training performed scans sequentially on participants. The maximum anteroposterior diameter of infrarenal aorta was measured. Measurement discrepancies between operators were compared against the clinically acceptable difference of 5mm. Scanning efficiency and aneurysm detection were statistically analysed.

Results: Among 71 participants, measurements were successfully attained by all operators in 66(93.0%) cases, and within clinically acceptable difference in 58(81.7%) cases between three operators – 16(72.7%) for inpatients and 42(95.5%) for volunteers. Measurement reproducibility substantially improved after standardisation of ultrasound technique on day one. Agreement on aneurysm detection was excellent between operators. Improvement in scanning efficiency from inpatients to volunteer groups was statistically significant.

Conclusion: For screening purposes, junior doctors were able to efficiently and reproducibly attain results comparable to sonographers in measuring the infrarenal aortic diameter after two hours of training. One day of supervised practice is recommended to institute standardised ultrasound technique for novices. Ultrasound AAA screening by junior doctors in rural Australia is feasible, cost-effective and should be advocated.

DIAPHRAGMATIC HERNIATION AFTER MINIMALLY INVASIVE OESOPHAGECTOMY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Peter Mac Callum Cancer Centre

Biography:

Adele is currently working as an unaccredited registrar at St Vincent's Hospital Melbourne. She is an aspiring surgeon with an interest in Upper Gastrointestinal and Vascular Surgery.

Aim Diaphragmatic hernia (DH) is a rare complication after oesophagectomy, associated with risks of obstruction and strangulation. Repair can be challenging due to the presence of the gastric conduit. We performed this systematic review and meta-analysis to determine the incidence and risk factors associated with DH following oesophagectomy, the timing and mode of presentation and outcomes of hernia repair.

Methodology A systematic search using PRISMA guidelines was performed using four major databases. A meta-analysis of DH incidence after MIO compared to open oesophagectomies was conducted. Qualitative analysis was performed for tumour location, associated symptoms, time to presentation and outcomes post DH repair.

Results A total of 17, 052 patients from 32 studies were included with 533 patients (3.1%) diagnosed with DH. The risk of DH was 2.72 times higher in MIO compared to open oesophagectomies. DH was more commonly seen following surgery for distal tumours, where crural fibers may be resected for oncological margin. 60.6% of patients were symptomatic at diagnosis. Presentation within 30 days occurred in 21% of cases, and are twice as likely to require emergent surgical repair compared to delayed presentations. Early DH recurrence and cardio-respiratory complications are common sequelae in patients after emergent repair.

Conclusion In the era of MIO, one has to be cognisant of the increased risk of post-operative DH and its subsequent sequelae. The majority of presentations are more than 30 days after initial surgery however, failure to recognise early DH can result in catastrophic consequences.

QUALITY OF LIFE IN CARERS OF CHILDREN WITH OESOPHAGEAL ATRESIA

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Biography:

Dr Sharman Tan Tanny is a Paediatric Surgery Research Registrar, currently undertaking PhD studies with The University of Melbourne, Murdoch Children's Research Institute, and The Royal Children's Hospital. She completed her medical degree at The University of Melbourne, and Masters in Surgical Sciences with The University of Edinburgh.

Purpose: The majority of children with oesophageal atresia (OA) have an inherent abnormality in oesophageal motility, affecting their long-term morbidity. This impacts the quality of life (QoL) of patients and their carers. There is rich literature describing QoL in OA patients. However, little is known about the impact upon carers.

Methodology: Utilising a prospective cohort study design, carers of children with OA were invited to complete the following questionnaires: (1) Parent Experience of Child Illness (PECI); (2) Patient-Reported Outcomes Measurement Information System (PROMIS) Anxiety; (3) PROMIS Depression; and; (4) Pediatric Quality of Life Inventory TM (PedsQL TM). Gross Type E OA patients were used as "control".

Results: Carers of 100 patients (M:F = 64:36, median age 4.6 years [3.5 months – 19.0 years]) completed questionnaires. The majority (76/100) of patients had Gross Type C OA. Associated anomalies were present in 30/100, ≥ 1 oesophageal dilatation was performed in 57/100, and fundoplication was performed in 11/100. When stratified by OA types, significant differences were found in two PEGI subscales (unresolved sorrow and anger, $p=.02$; uncertainty, $p=.02$) and in PROMIS Anxiety ($p=.02$). No significant differences were found when compared for associated anomalies, nor oesophageal dilatations. Previous requirement for fundoplication resulted in lower PedsQL TM social functioning score, as well as physical functioning score, in children aged two years and above.

Conclusion: In the largest study of its kind, this study has demonstrated that OA type, and requirement for fundoplication, had a significant impact upon the quality of life for carers.

MACHINE LEARNING APPLICATIONS TO CLINICAL DECISION SUPPORT IN NEUROSURGERY: AN ARTIFICIAL INTELLIGENCE AUGMENTED SYSTEMATIC REVIEW.

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The University of Notre Dame Australia

Biography:

Quin is a clinical researcher with 10 years of management consulting experience. He holds two Masters degrees in psychology and information systems and is an MD PhD Candidate. He has more than 20 peer-reviewed publications and has been published in: Neurosurgical Review, Journal of Neurosurgery, Neurosurgical Focus and Spine.

Background: Machine learning involves algorithms learning patterns in large, complex datasets to predict and classify. Algorithms include neural networks (NN), logistic regression (LR), and support vector machines (SVM). There is great potential for collaborative machine learning research involving surgeons, data scientists and technologists to generate substantial improvements in surgical quality and safety.

Objective: This systematic review assessed the current state of neurosurgical machine learning applications and the performance of algorithms applied.

Methods: Our systematic search strategy yielded 6866 results, 70 of which met inclusion criteria. Performance statistics analyzed included area under the receiver operating characteristics curve (AUC), accuracy, sensitivity and specificity. Natural language processing (NLP) was used to model topics across the corpus and to identify keywords within surgical subspecialties.

Results: Machine learning applications were heterogeneous. The densest cluster of studies focused on preoperative evaluation, planning and outcome prediction in spine surgery. The main algorithms applied were NN, LR and SVM. Input and output features varied widely and were listed to facilitate future research. The accuracy ($F(2,19)=6.56, p<0.01$) and specificity ($F(2,16)=5.57, p<0.01$) of NN, LR and SVM differed significantly. NN algorithms demonstrated significantly higher accuracy than LR. SVM demonstrated significantly higher specificity than LR. We found no significant difference between NN, LR and SVM AUC and sensitivity. NLP topic modeling reached maximum coherence at seven topics, which were defined by modeling approach, surgery type and pathology themes. Keywords captured research foci within surgical domains.

Conclusion: Machine learning technology accurately predicts outcomes and facilitates clinical decision making in neurosurgery. NNs frequently outperformed other algorithms on supervised learning tasks. This study identified gaps in the literature and opportunities for future neurosurgical machine learning research.