OTHR-12. THE DEVELOPMENT OF MACHINE LEARNING ALGORITHMS FOR THE DIFFERENTIATION OF GLIOMA AND BRAIN METASTASES – A SYSTEMATIC REVIEW

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PURPOSE: Medical staging, surgical planning, and therapeutic decisions are significantly different for brain metastases versus gliomas. Machine learning (ML) algorithms have been developed to differentiate these pathologies. We performed a systematic review to characterize ML methods and to evaluate their accuracy. METHODS: Studies on the application of machine learning in neuro-oncology were searched in Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL) and Web of science core-collection. A search strategy was designed in compliance with a clinical librarian and confirmed by a second librarian. The search strategy comprised of controlled vocabulary including artificial intelligence, machine learning, deep learning, magnetic resonance imaging, and glioma. The initial search was performed in October 2020 and then updated in February 2021. Candidate articles were screened in Covidence by at least two reviewers each. A bias analysis was conducted in agreement with TRIPOD, a bias assessment tool similar to CLAIM. RESULTS: Twenty-nine articles were used for data extraction. Four articles specified model development for solitary brain metastases. Classical ML (cML) algorithms represented 85% of models used, while deep learning (DL) accounted for 15%. cML algorithms performed with an average accuracy, sensitivity, and specificity of 82%, 78%, 88%, respectively; DL performed 84%, 79%, 81%. The support vector machine (SVM) algorithm was the most common used cML model in the literature and convolutional neural networks (CNN) were standard for DL models. We also found T1, T1 post-gadolinium and T2 sequences were most commonly used for feature extraction. Preliminary TRIPOD analysis yielded an average score of 14.25 (range 8–18). CONCLUSION: ML algorithms that can accurately classify glioma from brain metastases have been developed. SVM and CNN are leading approaches with high accuracy. Standardized algorithm performance reporting is a clear limitation to be addressed in future studies.

OTHR-13. IMPACT THE BRAIN: IMPROVING METASTATIC BREAST CANCER PATIENT ACCESS TO COORDINATED TREATMENT.

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Central nervous system (CNS) metastases are associated with decreased survival and quality of life for patients with metastatic breast cancer (MBC). Multi-disciplinary care can optimize outcomes. This project aims to improve access to coordinated care for patients with MBC and CNS metastases. Patients with MBC and CNS metastases are referred and offered to enroll in our care coordination program. A team consisting of specialists (breast medical oncology, breast cancer genetics, radiation oncology, neurosurgery, neuro-oncology, physical medicine and rehabilitation (PM&R), neuropsychology, and palliative care) supports a dedicated program coordinator who provides navigation, education, specialty referral, and clinical trial screening. A unique intake form developed for the program creates personalized, coordinated, and expedited referrals. Patient-reported outcomes and caregiver burden assessments are collected. Since May 2020, 43 patients were referred and a total of 40 patients (93%) were enrolled – 2 (5%) declined due to perceived burden of participation and 1 (2%) died before enrollment. 85% of patients were Caucasian (n = 34) and 15% were non-Caucasian (n=6). Median time to program intake was 1 day (range: 0–8 days). Of the 43 patients referred, 17 (40%) consented to research studies in the metastatic setting. 11 were for an interventional trial (65%), while 9 consents were for non-interventional studies (53%). In addition to the initially referred specialty, 56 referrals were made across 7 sub-specialties; 37 patients (66%) were subsequently seen by a sub-specialist, most commonly radiation oncology (n = 9), neuro-oncology (n=8), PM&R (n=8), and neuropsychology (n=8). Implementation of a care coordination program for patients with MBC and CNS metastases is feasible. Further, it allows for improved access to care across sub-specialties and supports participation in clinical research for a group of cancer patients historically underrepresented in research studies.

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OTHR-14. AN IMMUNOGENOMIC ANALYSIS OF MELANOMA BRAIN METASTASES (MBM) COMPARED TO EXTRACRANIAL METASTASES (ECM)

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BACKGROUND: MBM have a unique molecular profile compared to ECM. METHODS: We analyzed a previously published dataset from MD Anderson Cancer Center, including RNA-seq on surgically resected, FFPE MBM and ECM from the same patients. STAR pipeline was used to estimate mRNA abundance. DESeq2 package was used to perform differential gene expression (DGE) analyses. Pathway analysis was performed using Gene Set Enrichment Analysis (GSEA). Paired DGE and GSEA compared MBM vs. lymph node (LN) metastases (n = 16) and MBM vs. skin mets (n = 10). CIBERSORTx estimated relative abundance of immune cell types in MBM and ECM. GATK Mutect2 pipeline was used to call somatic mutations using paired normal tumor samples. Mutations were annotated using the Ensembl Variant Effect Predictor and visualized using the Maftools package in R. RNA-seq was available on 54 human primary cutaneous melanomas (CM). Gene Ontology or KEGG Pathway analysis was performed using goana function of limma package in R. RESULTS: Paired GSEA found that autophagy pathways may be up-regulated in MBM vs. LN and MBM vs. skin mets. On a single-gene level, the most strongly up-regulated genes in autophagy pathways were *GFAP* and *HBB*. Fold changes in other autophagy-related genes were low and did not reach significance. Comparison between CM which recurred in brain vs. CM which did not recur identified up-regulation of autophagy pathways. CIBERSORTx identified an increased proportion of immune suppressive M2 macrophages compared to tumor suppressive M1 macrophages in MBMs and ECMs. CONCLUSION: Up-regulation of autophagy pathways was observed in patient-matched MBM vs. LN and skin mets. This finding was driven by up-regulation of *GFAP* and *HBB*, which could reflect changes in the tumor microenvironment. Higher M2:M1 ratio may contribute to an immune suppressive tumor microenvironment and may be targetable. Validation of our findings in an independent Duke dataset is ongoing.

OTHR-15. ASSESSMENT OF TRIPOD ADHERENCE IN ARTICLES DEVELOPING MACHINE LEARNING MODELS FOR DIFFERENTIATION OF GLIOMA FROM BRAIN METASTASIS

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PURPOSE: Machine learning (ML) applications in predictive models in neuro-oncology have become an increasingly investigated subject of research. For their incorporation into clinical practice, rigorous assessment is needed to reduce bias. Several reports have indicated utility of ML applications in differentiation of glioma from brain metastasis. However, a systematic assessment of quality of methodology and reporting in these studies has not been done yet. We examined the adherence of 29 published reports in this field to the TRIPOD statement, which is similar to CLAIM checklist. MATERIALS AND METHODS: Our systematic review was conducted in accordance with PRISMA guidelines. Ovid Embase, Ovid MEDLINE, Cochrane trials (CENTRAL) and Web of science core-collection were searched. Keywords included artificial intelligence, machine learning, deep learning, radiomics, magnetic resonance imaging, glioma, and glioblastoma. Assessment of TRIPOD adherence in 29 eligible studies was performed. Individual item performance was assessed by adherence index (ADI), the ratio of mean achieved score to maximum score per TRIPOD item. RESULTS: In a preliminary analysis of 8 studies, the average TRIPOD adherence score was 0.48 (14.25/30 items fulfilled) with individual scores ranging from 0.27 (8/30) to 0.60 (18/30). Best overall item performance, with an ADI of 1, was seen in item 3 (Background/Objectives), 16 (Model performance) and 19 (Interpretation). Poorest performance was detected in item 1 (Title) and 2 (Abstract), followed by item 9 (Missing Data) with ADI of 0, 0 and 0.13, respectively. CONCLUSION: Preliminary results underline the lack of reproducibility in ML studies on distinction between glioma and brain metastasis. An average TRIPOD adherence score of 0.48 indicates insufficient quality of reporting and outlines the need for increased utilization of quality scoring