EDITORIAL

From "One-Size-Fits-All" to a precision medicine approach in neuro-oncology and neurology practice

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Precision medicine has gained more attention from the public since former U.S president Barack Obama launched a national "Precision Medicine Initiative" project in his 2015 State of the Union address. The concept of precision medicine is to customize the prevention and treatment regimen for each person based on precision information of genomics, environment, and lifestyle for that individual (1).

While precision medicine is a promising approach in every aspect of medical practice, one successful application of precision medicine to daily practice at the current time is cancer therapy, including brain tumor treatment. Previously, brain tumor treatment after diagnosis was a "one-size-fits-all" approach: surgery, radiation, and/or chemotherapy with fine tuning of doses. Currently, the management of brain tumors has begun to shift to the precision medicine approach based on the genomic information of each cancer. The 2016 World Health Organization (WHO) Classification of Tumors has integrated genomic alterations into the histopathological diagnosis of brain tumors (2). The new WHO classification has provided a platform for practicing precision medicine in neuro-oncology. For example, instead of the traditional classification of WHO grade II diffuse astrocytoma, the new classification is WHO grade II diffuse astrocytoma, plus IDH mutant or IDH wildtype. Studies have shown that IDH mutant type glioma has a better prognoses than IDH wildtype tumor (3). Therefore, even with the same histolopathological diagnosis, the low-grade astrocytoma with IDH wildtype is treated more aggressively than the tumor with mutant type (4). Another important biomarker, 1p19q, co-deletion defines oligodendroglioma in the current era regardless of the presence or absence of traditional histological "fried egg appearance". With this molecular signature, patients with oligodendrogliomas are treated with Procarbazine, CCNU and Vincristine (PCV) plus radiotherapy, as studies have shown that the median overall survival almost doubles with PCV plus radiotherapy compared to radiotherapy alone (5). O-6-methylguanine-DNA-methyltransferase gene (MGMT) promoter methylation status is a valuable prognostic biomarker that is used in glioblastoma evaluation and management. Patients with MGMT methylated glioblastoma have significantly increased survival when receiving Temozolomide chemotherapy along with radiation therpy (6). Thus, single agent Temozolomide is used to treat the elderly patients with MGMT methylated glioblastomas when the combined chemoradiation therapy is not feasible due to the poor functional status of the patient (7).

Immunotherapy and targeted therapy are on the path of finding evidence of efficacy for the treatment of primary brain tumors while they have already been successfully applied in the treatment of brain metastases harboring specific mutations or protein variants (8). Nivolumab and Ipilimumab combination therapy has increased the survival of patients who have advanced melanomas with brain metastases (9). Two targeted therapy agents have achieved promising results in the treatment of leptomeningeal carcinomatosis spreading from Non-Small Cell Lung Cancer (NSCLC): Osimertinib for positive EGFR (Epidermal growth factor receptor) mutated NSCLC and Alectinib for ALK (Anaplastic lymphoma kinase gene) rearranged NSCLC (10-12).

Along with neuro-oncology, other neurology subspeciality areas have progressed in gene identification, diagnostic biomarkers, and molecular imaging. This progress has laid a foundation for the application of precision medicine in the diagnosis and management of various neurological diseases, such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, epilepsy, multiple sclerosis, and mental disorders (13-16).

In the next decade, we expect to witness more exciting genomic discoveries that will revolutionize neurology practice through precision medicine.

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