An important new tool to assess chemotherapy response in cancer patients

Although chemotherapy agents are widely used in the treatment of cancer, it is not widely known that for many patients with solid tumours, only a fraction receive a survival benefit from chemotherapy. This is particularly the case when treatment is administered to patients with advanced breast cancer prior to surgery. Yet, the vast majority of patients experience significant and increasingly toxic side effects as continued rounds of chemotherapy are administered. These include heart and nerve damage, tremendous fatigue, infections, reduced fertility, the promotion of future cancers, and highly decreased quality of life. The only well-accepted indicator that breast cancer patients have responded to chemotherapy is the observation microscopically of complete destruction of all tumor cells in the breast and armpit lymph nodes at the end of treatment. Patients achieving complete tumour destruction have much longer survival without recurrence of their disease than patients who do not. However, the assessment of the patient for complete tumour destruction typically takes place after the last round of chemotherapy. In addition, only some types of breast cancer (there are at least five types) readily show complete tumour destruction. Thus, it would be ideal to have an effective tool to monitor chemotherapy response early in treatment that could be effectively used for all types of breast cancer and possibly other cancers.

We have recently discovered that early in treatment, patients responding to chemotherapy exhibit extensive degradation of ribonucleic acid in their tumors. Ribonucleic acid or RNA is produced from its sister molecule deoxyribonucleic acid (DNA) and is critical for cell survival. We now call this ability of chemotherapy drugs to induce tumor RNA degradation “RNA disruption” and we have developed a method to quantify RNA disruption in tumors (the RNA disruption assay). The assay allows patients to be classified based on whether their tumors show low, moderate, or high RNA disruption. In a recent study, we have been able to demonstrate that chemotherapy treatments induce tumor RNA disruption in many forms of breast cancer and that high RNA disruption during treatment is associated with complete tumour destruction after treatment. We further found that high mid-treatment tumor RNA disruption could predict enhanced cancer-free survival after chemotherapy across all types of breast cancer. This was even the case for patients that did not show complete tumour destruction post-treatment. If they showed high RNA disruption, they had a survival benefit equivalent to patients with complete tumour destruction after chemotherapy. This suggests that for some types of breast cancer, some tumor cells remain after treatment, but the tumor is dead. These exciting findings suggest that we have discovered a powerful new tool for evaluating the success of chemotherapy treatment in cancer patients. Patients exhibiting high tumor RNA disruption early in chemotherapy can continue treatment with confidence, while those with low RNA disruption can be considered at high risk of treatment failure. Such non-responding patients can then be spared the toxic side effects of continuing the ineffective chemotherapy regimen and rapidly moved to other treatment options, including surgery, radiation therapy, or different chemotherapy drugs.

Publication

RNA Disruption and Drug Response in Breast Cancer Primary Systemic Therapy.
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