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Opinion Article

Clinical Importance of Chemotherapy on Cancer Treatment

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ABOUT THE STUDY

Chemotherapy is one of the most commonly used cancer treatment strategies worldwide. It is designed to eliminate rapidly progressing cancer cells in the patient's body. The exact amount of chemotherapy drug that must be delivered into the patient's body determines the effectiveness of the treatment and determines the patient's survival during chemotherapy. Therefore, it is imperative to control the dose of chemotherapeutic drugs delivered to the patient. This study aims to propose Two-Degree-of-Freedom Proportional-Integral-Derivative (2FOPID) controller with set a point filter for implementing automated drug delivery control schemes during chemotherapy. The performance of the proposed W2FOPID is compared with Integral-Proportional-Derivative (IPD), Internal Model Control (IMC) and Fractional Order IMC (FOIMC) schemes. W2FOPID outperforms IPD, IMC, and FOIMC schemes by 79.9%, 25.3%, and 23.36% in terms of integrated absolute error, respectively. Additionally, W2FOPID has excellent set point tracking, noise reduction, and uncertainty handling capabilities.

According to the Indian Council for Medical Research (ICMR), 1.39 million cases of cancer were reported in India in 2020. The number of cancer cases is estimated to increase by another 12% by 2025. However, in the global scenario, the number of new cancer cases is projected to increase by 80% in developing countries and 40% in developed countries, resulting in 13 million cancer deaths by 2030. This is an alarming situation that needs to be addressed through multidisciplinary collaboration to advance the existing healthcare system. In general, cancer is a group of diseases classified by uncontrolled cell proliferation and division, resulting in irregular tissue development. Normal cells are transformed into malignant cells in three stages initiation, promotion and transition. Malignant tumor cells have the ability to invade adjacent tissues and kill normal (healthy) cells. These cells can spread to other parts of the body *via* the lymphatic or circulatory system, leading to the formation of new tumors. We are determined to develop competent therapies and therapeutic modalities to suppress. Common cancer treatments include surgery, chemotherapy, radiation therapy, targeted therapy, immunotherapy, hormone therapy, and stem cell transplantation. Among these methods, chemotherapy has received a great deal of attention in the scientific and cancer research communities. Chemotherapy works by targeting rapidly proliferating and regenerating cells. However, the underlying problem with chemotherapy drugs (chlorambucil, cyclophosphamide, cisplatin, carboplatin, etc.) is that they not only kill rapidly growing malignant cells, but also wipe out normal cells. This makes it essential to maintain and regulate adequate levels of chemotherapy drugs in the patient's body.

Previous studies have used parameterization and analytical gradients, adaptive elite population-based Genetic Algorithms (GA) memetic algorithms, and paladin distributed evolutionary control algorithms to accurately estimate optimal chemotherapy drug schedules. Various optimization techniques have been exposed to be employed. The strategy discussed using analytical gradients to the paladin distributed evolutionary control algorithm was ineffective when drug concentrations and toxicities deviated from optimal values throughout the treatment process. Because the above regimens are inherently open-loop, drug dosages cannot be adjusted in a precise manner. To alleviate this problem, experts have used closed-loop control of drug concentrations during chemotherapy. A GA-based cascade Proportional-Integral-Derivative (PID) control scheme has been proposed to control cancer growth. Furthermore, its performance is compared with conventional PGD and other drug planning methods. In addition, Multi-Objective GA (MOGA) based PID and I-PD (Integral-Proportional-Derivative) controllers were implemented for single and multi-drug regimen strategies to control cancer growth. The reported effects display that the proposed strategy is more robust to parametric variations. In another pioneering study, three control schemes for optimal and robust control of drug delivery were designed and compared. Furthermore, a new robust basic control configuration was used to control angiogenic inhibition of tumor growth. The results demonstrate the efficiency of the recommended control scheme for various tumor volumes. Another study used an adaptive PI controller based on the lyapunov method to control tumor size. The effects display that the system is overall stable and robust to variations in model parameters. In addition, a modified FOIMC 2-DOF-PID (2-Degree of Freedom-PID) and an optimal control regimen for

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drug dose control at the tumor site are proposed. Additionally, NASGA-II optimized control of multidrug regimens during chemotherapy has been described. Other strategies include developing different types of fuzzy logic controllers to control anticancer drug delivery systems. Additionally, reinforcement learning-based control, robust optimal control, and adaptive control schemes have been implemented in this context. The reported effects display that the proposed strategy is more robust to parametric variations. In another pioneering study, his three control schemes for optimal and robust control of drug delivery were designed and compared. Furthermore, a new robust basic control configuration was used to control angiogenic inhibition of tumor growth.

CONCLUSION

The effects demonstrate the efficiency of the recommended control scheme for various tumor volumes. Another study used an adaptive PI controller based on the lyapunov method to control tumor size. The effects display that the system is overall stable and robust to variations in model parameters. In addition, a modified FOIMC 2-DOF-PID (2-Degree of Freedom-PID) and an optimal control regimen for drug dose control at the tumor site are proposed. Additionally, NASGA-II optimized control of multidrug regimens during chemotherapy has been informed. Other strategies include developing different types of fuzzy logic controllers to control anticancer drug delivery systems. Additionally, reinforcement learning-based control, robust optimal control, and adaptive control schemes have been implemented in this condition.