Early and Often: Can Liquid Biopsies be the Key to Catching Cancer?

MICR 3233-PHYS 4010

Abstract

Examining cancer cells is essential for effectively treating and understanding the disease. In the last ten years, liquid biopsies have come into space and brought with them lots of excitement. The liquid biopsy's noninvasive nature and surprising accuracy have led to their wider use and sound effect. As this technology continues to evolve and improve, hopefully, it will be able to continue to aid in the fight against cancer.

Introduction

Testing and detecting cancers are paramount for the successful treatment of cancer. The most readily available statistics on how important early cancer detection is the 5-year survival rate of breast cancer. The survival rate is 70% higher for cancer detected in the localized stage rather than the distant stage. (*Survival Rates for Breast Cancer*, n.d.) The advances in technology have evolved to a place that makes cancer detection much more straightforward with tools that have been around for years, such as MRI and CAT scans and new technologies like liquid biopsy. The liquid biopsy is especially interesting because it is unique and different from other cancer detection methods. A biopsy is the removal and examination of tissue, cells, or fluids from the living body (*Biopsy Definition & Meaning - Merriam-Webster*, n.d.) and a liquid biopsy is a blood sample that is taken and examined for specific markers of cancer. In the case of cancer detection, the biopsy tests for cell-free circulating tumor DNA (ctDNA), circulating free proteins, RNA fragments, and other particles related to cancerous cells. (Husain & Velculescu, 2017) This technology was introduced in 2010 and has since taken off in its capabilities. It originally was used to detect circulating tumor cells, cells that have broken off of a tumor and are floating freely in the blood. Now the focus has shifted to cancer markers, such as the ctDNA, mRNA, proteins, and tumor-educated platelets. (Alix‐Panabières & Pantel, 2021)

Recent Progress

Recently it has shown great promise in late-stage cancer, but questions have come up about its efficacy in earlier stages. This is partly because of the small amount of cell-free DNA (ccfDNA) that early-stage tumors release (1% of total ccfDNA for early-stage cancers compared to 40% of total ccfDNA for late-stage). Although these concerns are valid, the technology has been expanding to identify more prevalent markers earlier in cancer's progression. Proteins are a significant target for the expansion of these tests. Liquid biopsies have also shown promise in identifying specific mutations in tumors. This has many implications for the treatment of cancer. (Neumann et al., 2018)

Problems

Any new technology comes with flaws or maybe aspects that were not formerly thought of. Liquid biopsy is no exception. It is noninvasive, which already gives it a leg up on a standard biopsy. One of the main issues faced with liquid biopsy is its implementation. Doctors or those at risk for cancers (previously identified genetic mutation, family history, or tobacco users, for example) may not want to risk using a new technology that is still new and not perfected. Another area slowing down the implementation is the lack of data on outcomes. There is very little data about whether or not liquid biopsies decrease mortality rates or aid ineffective treatment. (Kwo & Jenna Aronson, 2021) Another issue that is coming to the forefront of the liquid biopsy discussion is setting clear guidelines for their use. At the moment there is no rule of thumb about the levels the test needs to show to begin treatment. With no level and the risk of overtreatment the doctors are forced to go ahead and do a regular biopsy to verify and then begin treatment if necessary. This is a problem that while not hard to solve necessarily is going to take some time to iron out.

Discussion

With all-new technologies in biology and medicine comes questions, and liquid biopsies are no exception. In what role are the most effective, how accurate are they, and can they replace other more invasive tests? The test is not in its final form, but it is still effective in its present state. It seems to play several valuable roles in detecting and treating cancer. Still, its most effective role is its ability to detect mutations in tumors that allow doctors to use the best treatment for the cancer type. (De Mattos‐Arruda & Caldas, 2016)It also shines because it will enable biopsies of tumors that are hard to reach or in dangerous places. Its accuracy continues to improve. It's not an issue of false positives but perhaps false negatives due to the test's sensitivity. As more biological markers associated with cancer are found, the test will undoubtedly continue to improve its sensitivity. The liquid biopsies are another tool in the bag for diagnosis and treatment of cancer, but it is not and may not ever be the thing to replace more traditional technologies. Liquid biopsies are a noninvasive tool that, when used correctly, could change the way doctors treat and diagnose cancer. (Finotti et al., 2018)

Reference

Alix‐Panabières, C., & Pantel, K. (2021). Liquid biopsy: From discovery to clinical implementation. *Molecular Oncology*, *15*(6), 1617–1621. https://doi.org/10.1002/1878-0261.12997

*Biopsy Definition & Meaning—Merriam-Webster*. (n.d.). Retrieved March 3, 2022, from https://www.merriam-webster.com/dictionary/biopsy

De Mattos‐Arruda, L., & Caldas, C. (2016). Cell‐free circulating tumor DNA as a liquid biopsy in breast cancer. *Molecular Oncology*, *10*(3), 464–474. https://doi.org/10.1016/j.molonc.2015.12.001

Finotti, A., Allegretti, M., Gasparello, J., Giacomini, P., Spandidos, D. A., Spoto, G., & Gambari, R. (2018). Liquid biopsy and PCR-free ultrasensitive detection systems in oncology (Review). *International Journal of Oncology*, *53*(4), 1395–1434. https://doi.org/10.3892/ijo.2018.4516

Husain, H., & Velculescu, V. E. (2017). Cancer DNA in the Circulation: The Liquid Biopsy. *JAMA*, *318*(13), 1272–1274. https://doi.org/10.1001/jama.2017.12131

Neumann, M. H. D., Bender, S., Krahn, T., & Schlange, T. (2018). CtDNA and CTCs in Liquid Biopsy – Current Status and Where We Need to Progress. *Computational and Structural Biotechnology Journal*, *16*, 190–195. https://doi.org/10.1016/j.csbj.2018.05.002

*Survival Rates for Breast Cancer*. (n.d.). Retrieved March 2, 2022, from https://www.cancer.org/cancer/breast-cancer/understanding-a-breast-cancer-diagnosis/breast-cancer-survival-rates.html