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Commentary

Adequacy and Accuracy of Biopsy Specimen Acquisition During Longitudinal Sampling: Importance and Improvement

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INTRODUCTION

Tumor biopsy specimen assessments examine tumor tissue and the tumor microenvironment (TME) to aid in diagnosing and understanding the biology of cancer. Innovative and novel digital techniques for performing biopsies could largely improve specimen acquisition; thereby, improving cancer research, diagnosis, and treatment.

THE TUMOR MICROENVIRONMENT (TME)

The TME is a highly complex, heterogeneous, and dynamic environment within and around tumors. The TME consists of various cell types, including tumor cells, stromal cells, and immune cells, as well as a variety of noncellular molecules, enzymes, and other matter released from cells. The TME plays a critical role in cancer initiation and progression. It is well known that certain components in the TME are implicated in disease progression as well as in therapeutic outcomes. The components in the TME can shape and reprogram tumor progression. Currently, cancer therapy strategies have been increasingly switched from tumor targeted to TME targeted.[1–3] A comprehensive understanding of the TME—its biological and molecular composition, cellular interactions, and physiology—is critical to elucidate the underlying mechanism of cancer; thus, improving cancer diagnosis and treatment.

Tumor Biopsy Specimens Representing TME

Characterization and analysis of the TME largely rely on the assessment of representative tumor biopsy specimens.[4] These specimens play an important role not only in diagnosing cancer but also in studying drug efficacy and enabling more effective treatments. Additionally, the specimens allow direct assessment of the tumor and the surrounding environment, providing valuable insights into disease progression and identifying biomarkers,[5] especially in immuno-oncology research. The acquisition and quality of biopsy specimens is critical for precise investigation of the TME in cancer research.[6,7] To longitudinally monitor the dynamic changes and gain a comprehensive understanding of the TME, serial biopsy sampling before and after treatment is performed. This sampling detects the changes of rapidly changing TME and examines the influence of therapeutic treatments. The biospecimens capture not only the complete cellular mix that can be found in any tumor, but also their spatial relationships and relative location. Tissue integrity must be maintained during the biopsy procedure to allow an analyst to assess this relationship. Currently, spatial transcriptomics and proteomics are new techniques that are being developed and more widely reported. [8–11]

Importance of Biopsy Specimen Acquisition

It is critical to acquire enough representative tumor biopsy specimens for evaluation and downstream analysis. Some studies suggested that the minimal DNA input for next-generation sequencing assay is 10 ng.[12,13] The accuracy and adequacy of longitudinal biopsy sampling has a significant effect on the subsequent analysis[14,15] as well as on tumor and treatment outcome evaluation.[16] Tumor biopsy specimen acquisition usually is performed by an interventional radiologist; however, it requires collaborative efforts from multidisciplinary clinical and research teams. In addition to tumor characteristics, the accuracy and adequacy of biopsy specimens depend on factors such as needle gauge, lesion size, and image-guided techniques. Also important are logistic factors, such as biopsy specimen collection workflow, financial support, and efficient information

exchange between interventional radiologists and multidisciplinary clinical and research teams.

IMPROVING THE ADEQUACY AND ACCURACY OF BIOPSY SPECIMEN ACQUISITION

Given the tumor and lesion heterogeneity and varied factors that affect biopsy specimen acquisition, it is challenging to accurately identify the representative tumor specimen in a longitudinal sample collection. Because it is quite difficult in current clinical practice to take a second biopsy from the same location, the order of sampling procedures is critical. It is important to enhance timely communication between interventional radiologists and clinical and research teams.[17,18] The lesions are handled by a multidisciplinary team for various purposes as follows: diagnostic radiologists identify and assess lesions; radiation oncologists evaluate lesions for possible radiation treatment; based on the data, the oncology study team determines lesions to be treated; and interventional radiologists perform designated biopsy specimen collection. Therefore, collaborative efforts from all parties are required.

Because timely communication and efficient workflow improve biopsy specimen acquisition, the web-based Naing lesion selection tool (LST) has been developed.[19–21] The Naing LST plays a central role in allowing the oncology study team to coordinate and gather data from multidisciplinary teams. It can be easily accessed by authorized personnel to monitor and facilitate the biopsy specimen acquisition workflow. The Naing LST provides real-time guidance for targeted lesion selection for various purposes. It is user friendly and features automatic popup notifications to minimize personnel efforts and speed up workflow. In short, the primary value of the Naing LST is the timely integration of all essential information in a centralized database.

CONCLUSION

The Naing LST is a simple, effective instrument easily implemented in clinical practice. In a retrospective study,[19] the Naing LST improved the accuracy of lesions biopsied and increased the total number of cores obtained. The Naing LST database and related workflow can be incorporated into existing online databases with only minimal technical support required. Regardless of its simplicity and effectiveness, the current Naing LST has the following limitations: (1) the Naing LST was completed on a volunteer basis, so the completion rate was low: only 30 out of 88 (34%) patients completed the Naing LST workflow; (2) additional efforts and technical expertise are required to maintain the database and related workflow; (3) currently, the Naing LST is not incorporated into electronic medical records but must be accessed via a separate browser. To overcome these limitations and implement the tool in clinical practice, financial support as well as clinical and academic recognition are needed to make this a standard tool for lesion selection.

References

1. Bejarano L, Jordao MJC, Joyce JA. Therapeutic targeting of the tumor microenvironment. *Cancer Discov*. 2021;11:933–959.
2. Roma-Rodrigues C, Mendes R, Baptista PV, Fernandes AR. Targeting tumor microenvironment for cancer therapy. *Int J Mol Sci*. 2019;20:840.
3. Tsai MJ, Chang WA, Huang MS, Kuo PL. Tumor microenvironment: a new treatment target for cancer. *ISRN Biochem*. 2014;2014:351959.
4. Lara OD, Krishnan S, Wang ZH, et al. Tumor core biopsies adequately represent immune microenvironment of high-grade serous carcinoma. *Sci Rep*. 2019;9:17589.
5. Ziv E, Durack JC, Solomon SB. The importance of biopsy in the era of molecular medicine. *Cancer J*. 2016;22:418–422.
6. Tapia C, Aung PP, Roy-Chowdhuri S, et al. Decrease in tumor content assessed in biopsies is associated with improved treatment outcome response to pembrolizumab in patients with rare tumors. *J Immunother Cancer*. 2020;8:e000665.
7. Ziv E, Durack JC, Solomon SB. The importance of biopsy in the era of molecular medicine. *Cancer J*. 2016;22:418–422.
8. Nerurkar SN, Goh D, Cheung CCL, et al. Transcriptional spatial profiling of cancer tissues in the era of immunotherapy: the potential and promise. *Cancers (Basel)*. 2020;12:2572.
9. Wu YC, Cheng YF, Wang XD, et al. Spatial omics: navigating to the golden era of cancer research. *Clin Transl Med*. 2022;12:e696.
10. Yoosuf N, Navarro JF, Salmén F, et al. Identification and transfer of spatial transcriptomics signatures for cancer diagnosis. *Breast Cancer Res*. 2020;22:6.
11. de Vries NL, Mahfouz A, Koning F, de Miranda NFCC. Unraveling the complexity of the cancer microenvironment with multidimensional genomic and cytometric technologies. *Front Oncol*. 2020;10:1254.
12. Goswami RS, Luthra R, Singh RR, et al. Identification of factors affecting the success of next-generation sequencing testing in solid tumors. *Am J Clin Pathol*. 2016;145:222–237.
13. Cho M, Ahn S, Hong M, et al. Tissue recommendations for precision cancer therapy using next generation sequencing: a comprehensive single cancer center's experiences. *Oncotarget*. 2017;8:42478–42486.
14. Pearce DA, Arthur LM, Turnbull AK, et al. Tumour sampling method can significantly influence gene expression profiles derived from neoadjuvant window studies. *Sci Rep*. 2016;6:29434.
15. Oh J, Carlson JCT, Landeros C, et al. Rapid serial immunoprofiling of the tumor immune microenvironment by fine needle sampling. *Clin Cancer Res*. 2021;27:4781–4793.
16. Keil S, Barabasch A, Dirrichs T, et al. Target lesion selection: an important factor causing variability of response classification in the Response Evaluation Criteria for Solid Tumors 1.1. *Invest Radiol*. 2014;49:509–517.
17. Ferry-Galow KV, Datta V, Makhlouf HR, et al. What can be done to improve research biopsy quality in oncology clinical trials? *J Oncol Pract*. 2018;14:JOP1800092.
18. The National Cancer Institute. Study improves the quality of biopsy specimens for cancer research. Oct 23, 2018. Accessed May 17, 2022. www.cancer.gov/news-events/cancer-currents-blog/2018/improving-cancer-research-biopsies
19. Xu M, Tapia C, Hajjar J, et al. Implementation of a novel web-based lesion selection tool to improve acquisition of tumor biopsy specimens. *J Immunother Precis Oncol*. 2021;4:45–52.
20. Subbiah V. Tissue is Still the issue for precision oncology: a novel web-based platform for lesion selection and biopsy specimen acquisition. *J Immunother Precis Oncol*. 2021;4:176–177.
21. Limaye S. Synchronized tissue acquisition techniques for novel biomarker discovery: are you ready to waltz? *J Immunother Precis Oncol*. 2021;4:168–169.