Editorial

Precision Pathology: A New Frontier

Precision medicine, the approach towards disease treatment and prevention that considers the individual genes, environment, and lifestyle of each patient, depends on precision pathology. But what exactly is precision pathology? Unlike traditional pathology which applies manual pattern recognition, precision pathology employs cutting-edge techniques to identify the etiological factors of a disease and optimize treatment by focusing on the therapeutic targets. Precision pathology has two main tasks: 1) define the treatment goal and therapeutic target, and 2) optimize treatment specific to the patient. Thus, to succeed in treatment pathologists must first determine the causative agents of disease and proper therapeutic targets. Then, we tailor treatment according to an expected physiological and pathological response based on the patient's metabolism.

Traditional pattern recognition methods have and are used by pathologists for adequate diagnosis and classification of diseases; however, their accuracy and efficiency leave a lot to be desired. To combat the need to analyze vast amounts of clinical information, precision pathology techniques involving artificial intelligence (AI) must be implemented. As seen in hematopathology, integrated approaches have already greatly improved pathological diagnosis and classification of diseases [Figure 1, left]. However, because this approach still relies on pattern recognition, even with gene profiling, molecular tumor classifications frequently contain genes irrelevant to tumor development [1]. For example, one algorithm of Burkitt lymphoma (BL) classification employs 196 genes, most of which are tissue-specific, lymphocyte-specific, B cell-specific and germinal center cell-specific [2, 3]. Despite being considered the driving force behind BL, c-MYC aberrant expression was no longer required for BL diagnosis [4]. This approach remains widely accepted as part of the mainstream diagnostic strategy simply because we lack an alternative.

Precision pathology diagnoses disease while providing ideal therapeutic targets [Figure 1, right]. Sometimes neither diagnosis nor classification is even necessary. For example, when *JAK2* mutations were identified in myeloproliferative neoplasm and B-cell acute lymphoblastic leukemia, treatment was identical - to target mutated *JAK2* [5, 6]. Similarly, when overexpressed c-MYC is detected in a lymphoma, c-MYC inhibition might be a reasonable strategy, regardless if the tumor appears to be a BL, diffuse large B-cell lymphoma (DLBCL), or something in between [7]. Under this approach, is it still necessary to devote resources and effort to determine the germinal center origin simply because of CD10 expression or mantle zone origin due to its CD5 positivity? Instead, cyclin D positive mantle cell lymphoma may be treated differently from cyclin D negative mantle cell lymphoma, while c-MYC expressing BL can be approached separately from c-MYC negative BL. As more therapeutic targets are defined via low-cost molecular assays, traditional morphologic reviews, immunophenotypic studies, cytogenetic analysis, and molecular profiling will become indispensable. These saved resources will be essential for identifying key therapeutic targets, delineating inter-pathway interactions, and evaluating an individual's response to treatments. Such a change is so radical that pathology textbooks will have to be rewritten, and the standard of pathology practice be completely updated.

By employing AI, precision pathology will be an automated process with well-trained pathologists overseeing the performance of the diagnosis process. To embrace this exciting turning point in the history of pathology, starting with this issue *Hematopathology* will publish review articles from expert patholo-

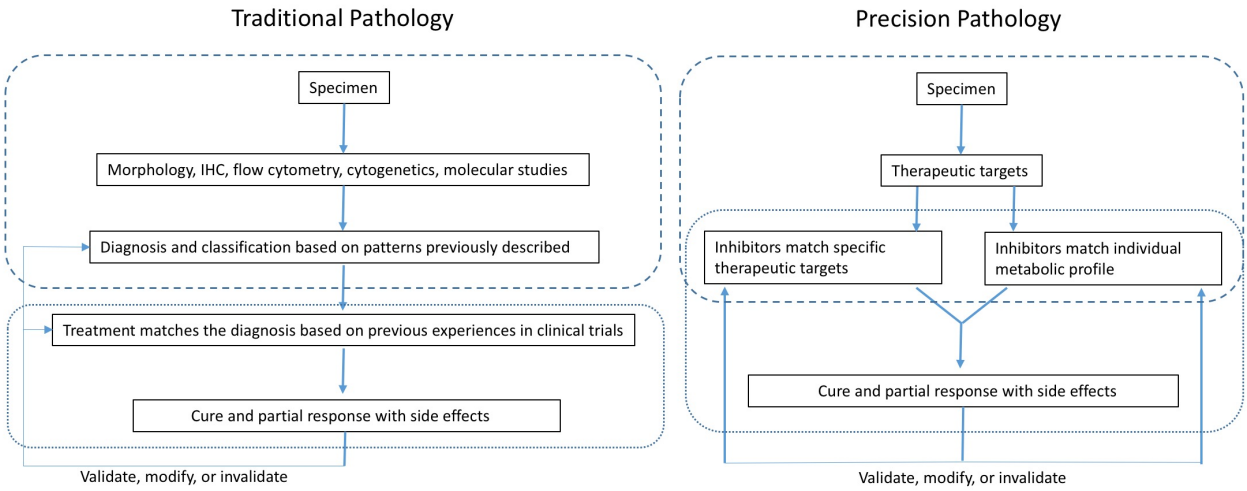

Figure 1: Comparison of Traditional Pathology (left) and Precision Pathology (right). The procedures inside of the rough broken lines are within the scope of pathologists; the procedures inside of the fine broken lines are within the scope of clinicians. There are some overlaps between pathologist and clinician duties in Precision Pathology, suggesting more involvement in clinical decision making by pathologists.

gists sharing their perspectives on the current role of pathology in the era of precision medicine [8], and how the rise of precision pathology will revolutionize healthcare.

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