Editorial

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Comprehensive outlook of Cell Pathology

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Pathology is one of the oldest medical disciplines, one that can be arguably rooted early in Egyptian medicine and Traditional Chinese Medicine 5,000 years ago [1,2]. In ancient times, documentation of diseases relied on the understandings of anatomy and observations of abnormalities that deviated from normal physiology. For many centuries ensued, vast knowledge was accumulated from observations of pathological conditions and autopsies, it is this wealth of information that laid the foundation for the modern medicine we see today.

In the early beginning, pathology focused on morphological abnormalities. Random documentation of broken bones, abnormal masses, skin discoloration evolved into systematic gross anatomy in modern pathology in the 19th century [2,3]. The invention of the microscope in the 19th century was undoubtedly another force that propelled pathology and medicine forward, moving us from organ-based to cell-based pathology with this "new technology". Along with the microscope, other technological advances such as tissue fixation, embedding, microtomes, and biological stains, all enabled the practice of histopathology possible. However, for a century, despite the improvement of microscopes and a plethora of ancillary diagnostic tests (i.e. electron microscopy, fluorescent microscopy, immunohistochemistry, cytogenetics), the importance of detecting morphological abnormalities remained constant and central to scientific discoveries, journal publications, and patient care as research focuses moved from organs to cells, from organelles to chromosomes.

In recent decades, we have seen an explosion of technologies in science, which enabled comparisons of normal *vs*. diseased states at molecular levels. Soon, analyses of DNA (single nucleotide polymorphism profiling, whole exome sequencing, cell-free DNA screening, etc.), RNA (RNA-Seq, single cell RNA-Seq, miRNA-Seq, ribosome profiling, etc.), protein (protein microarray, mass spectrometry, quantitative proteomics, etc.), epigenome (ChIP-Seq, whole-genome bisulphite sequencing), and metabolome (MS-based metabolites or lipid profiles) at various depths and throughputs became a common practice in experimental approaches and journal publications [4,5]. These molecular analyses not only can identify dysfunctional genes and/or pathways that are responsible or have contributed to the diseased state and structural abnormalities that can be visualized grossly or under a microscope, but may also offer insights for personalized medicine. For instance, in the era of precision medicine for cancer treatment, we have come to recognize that not only there are differential sensitivities to a given therapy among patients, there exists cellular heterogeneity in a patient's tumor. Therefore, a histological diagnosis of cancer in a patient can be complemented by molecular analyses to devise a personalized therapy that matches the tumor's molecular profile. It is also the hope that advances in liquid biopsies and artificial intelligence will someday replace the need for tissue biopsy in disease diagnosis, although many obstacles remained [6].

Cell pathology can be defined at cellular, organelle, and molecular levels, and can be detected by histological analysis, functional assays, or molecular analyses. Genetic mutations, epigenetic changes, or metabolic dysfunction can all contribute to the pathogenesis of a disease. Presently, diagnosis of a disease often encompasses a combination of physical, gross, histological, and molecular examinations. Take the current COVID-19 as an example, the emergent of the disease was first noted for the abnormal pathology of the lungs in SARS-CoV-2 infected patients [7], which eventually led to the development of PCR-based diagnostic tests. To understand and combat COVID-19 take concerted efforts of comprehensive cellular and molecular investigations, in vitro and in vivo experiments, human and animal studies. We recognize that abnormal state of cells can be presented in a multifaceted manner, therefore it is only fitting that our journal, Cell Pathology, embraces anatomical, cellular, molecular, computation, mechanobiological, and organismal investigations of cell pathology, because only through inclu-

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sion of complementary innovations and comprehensive studies that we could truly make significant advances in our understandings of human cell pathology and disease.

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