

사이토피노믹스와 히스토�피노믹스에서 외과병리학자의 역할

김종재 · 지제근¹

웨인주립대학교 의과대학 병리학교실, ¹서울대학교 의과대학 병리학교실

A Role for Surgical Pathologists in 'Cytophenomics' and 'Histophenomics'

Chong Jai Kim and Je G. Chi¹

Department of Pathology, Wayne State University School of Medicine, Detroit, Michigan, USA

¹Department of Pathology, Seoul National University College of Medicine, Seoul, Korea

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Rapid advances in molecular biology and bioinformatics have initiated a new era of high-dimensional biology and, now, we are quite familiar with the term "Omics". Omics is a general term for a broad discipline of science and engineering dedicated to analyzing the interactions of biological information objects in various "omes". These include terms such as genome, proteome, metabolome, expressome, interactome, etc.¹

All of omics technology is characterized by simultaneous acquisition of a large amount of data and application of sophisticated data analysis platforms for the interpretation of results, which do not seem to be related to routine surgical pathology practice.² Therefore, the majority of hospital pathologists may feel that they are running behind modern technology and, also, that these high-dimensional biological approaches are superior to conventional surgical pathology. Particularly, this might be the case for a younger generation of pathologists who are in the middle of their training. They might think that surgical pathology is boring and an out-of-date discipline.

In this letter, we would like to argue that surgical pathologists have been applying and leading more sophisticated omics technology for a long time, ahead of other omics technologies, and

that surgical pathology, indeed, is the most well-defined version of omics without significant false-negative results in contrast to other omics paradigms. Since the era of Rudolf Virchow, microscopic observations have provided a fundamental basis for both hospital pathology and experimental pathology. Bussolati, in his inspiring article titled "Dissecting the pathologist's brain: mental processes that lead to pathological diagnoses", summarized the mental processes, which lead to interpretation of images in pathology, in four sequential steps: 1) to look, 2) to see, 3) to recognize, and 4) to understand.³ Surgical pathologists evaluate the overall histological architecture of individual lesions (step 1 and step 2), and then figure out their clinical significance from the perceived information (step 3 and step 4). Therefore, surgical pathologists not only perceive the morphome of the disease process but also define and predict the clinical phenotype of disease (the phenome of the disease process). What is the key frame of cytological and histological diagnosis? It comprises primarily the global changes in cellular morphology and the proportion of the cells. In its nature, surgical pathology applies omics principles: evaluation of the changes in a large number of various cells simultaneously and interpretation of the disease process using a sophisticated platform of the pathologist's brain. If we see more neutrophils than expected in a given tissue, then it is perceived as acute inflammation. If we see a couple of signet ring cells in the gastric mucosa, it is regarded as a signet ring cell carcinoma. However, since not all signet ring cells are cancer cells, the swift diagnosis has to go through a long process of reasoning inside the pathologist's brain. We believe that no other omics

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Corresponding Author

Je G. Chi, M.D.
Department of Pathology, Seoul National University College of Medicine, 28 Yeongeong-dong,
Jongno-gu, Seoul 110-799, Korea
Tel: 02-544-9890
Fax: 02-517-9920
E-mail: chi3802@hotmail.com

technologies so far can detect subtle changes in a tiny number of cells within a bulk of tissue and have that sophisticated analysis software.

We propose the use of two terms herein, “cytophenomics” and “histophenomics”, which basically refer to “surgical pathology” as pathologists have been practicing for decades. Pathologists link cyto- and histo- morphome to cyto- and histo- phenomics. We could describe marked differences in the transcriptome of the human amnion based on subtle histological differences.⁴ Detailed evaluation of histological alterations as well as the role for qualified and experienced pathologists are becoming more important than ever with advances in biology. We would like to ask the residents in pathology training to do their best to expand their experiences and knowledge in cytopathology and histopathology of various organs. Interpretation of “global” changes occurring in tissues would not be possible without the sound knowledge and confidence of each surgical pathologist. We, as pathologists, have been doing excellent cytophenomics and histophenomics, and will continue to do so for years to come.

Surgical pathology, using the power of hematoxylin and eosin, is the most effective omics technology, and far surpasses other omics paradigms.

We hope that our message is well-received by the readers.

Sincerely,

Chong Jai Kim and Je G. Chi

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