形と皮膚疾患をつなぐ数理皮膚医学

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Chronic spontaneous urticaria (CSU) is one of the most intractable human-specific skin diseases. However, as no experimental animal model exists, the mechanism underlying disease pathogenesis in vivo remains unclear, making the establishment of a curative treatment challenging. Here, using a novel approach combining mathematical modeling, in vitro experiments and clinical data analysis, we demonstrate that the pathological state of CSU patients can be inferred by geometric features of the skin eruptions. Based on our hierarchical mathematical modelling, the eruptions of CSU were classified into five categories with distinct histamine, basophils, mast cells and coagulation factors network signatures. The analysis of 105 real CSU patients with this classification by six individual dermatologists achieved 87.6% agreement. The network analysis revealed that the coagulation status likely determines boundary/area pattern of wheals, while the state of spontaneous histamine release from mast cells may contribute to the divergence of size and outline of the eruptions. Thus, our study not only demonstrates that pathological states of diseases can be defined by geometric features but will also facilitate more accurate decision-making to manage CSU in the clinical setting.

References

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