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免疫球蛋白重链可变段和T细胞受体可变段的分子进化研究

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摘要 为阐明免疫球蛋白(Ig)和T细胞受体(TCR)在抗体多样笥产生机理上的异同，作者比较了Ig重 链可变段(Ig VH)和TCR可变段(TCR V) 的密码子替代率和协同进化，并分析异同的原因。共 搜集8种鼠和3种人的TCR α链可变段(Vα)，11种鼠和1种人的TCRβ链可变段(Vβ)，以及2 种鼠和4种人的T细胞γ链可变段；同时搜集11种鼠、3种人、3种南美鳄鱼和1种鲨鱼的Ig VH 。研究结果揭示：(1)对编码蛋白质的密码子来说，TCR V(包括Vα和Vβ)的核苷酸替代率为 Ig VH的2.4倍，说明前者有更高的替代率。(2)以协同进化而言，TCR V和Ig VH的基因重复 率分别为1.7×10-8和1.6×10-6/基因年，两者几乎相同，均系低速保持者。TCR V的数目(V α为100，Vβ为30)远少于Ig VH(数目为300)，原因是前者受到主要组织相容性复合体的制 约，即受到负选择，这与中性学说观点相一致。文章还讨论了体细胞突变和DNA重排对两类 抗体多样性产生上的作用，并探讨了Ig VH和TCR V的假基因问题。

关键词 分子进化,协同进化,免疫球蛋白,T细胞受体,中性学说

分类号

Study on Molecular Evolution for both Variable Segments of Immunoglobulin Heavy Chain and T Cell Receptor

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Abstract

In order to exlain difference and similarity in producing antibody diversity bet ween immunoglobulin (Ig) and T cell receptor (TCR),authors compared both codon s ubstitution and concerted evolution rate between the variable segment of Ig heav y (Ig Vh) and that of TCR (TCR V).The protein sequences of TCR Vα(including 8 g ene segments from mouse and 3 from human),TCR Vβ(including 11 from mouse and on e from human) and T cell Vγ (including 2 from mouse and 4 from human)were comp iled,as well as the protein sequences of Ig Vh (3 from human 11 from mouse, 3 fr om caiman and one from shark) were collected.It is shown that:(1) the nucleotide substitution of TCR V segment is 2.4 times as large as that of Ig Vh in coding region; (2) as for concerted evolution,gene duplicate rates in TCR V and Ig Vh ar e 1.7×10 -8 and 1.6×10 -8/gene/year,respectively.The number of TCR V(Vα equal s to 100 and Bβ equals to 30) is less than the one of Ig Vh (Vh equals to 300) ,for TCR V is subject to negative selection of major histocompatibility complex according to the neutral theory We discussed that is somatic mutation or DNA rea rrangement the main force in producing antibody diversity and are there pseudoge nes in TCR V or not.

Key words Molecular evolution Concerted evolution Immunoglobulin T cell receptor Neutral t heory

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