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I. 簡答與問答題

1. An abstract from Immunity 33, 1–13, 2010: "Heparan sulfate can bind several adhesion molecules involved in lymphocyte trafficking. However, the in vivo function of endothelial heparan sulfate in lymphocyte homing and stimulation of the immune response has not been elucidated. Here, we generated mutant mice deficient in the enzyme Ext1, which is required for heparan sulfate synthesis, in a Tek-dependent and inducible manner. Chemokine presentation was diminished in the mutant mice, causing the lack of appropriate integrin-mediated adhesion, and resulted in a marked decrease in lymphocyte sticking to high endothelial venules and in recruitment of resident dendritic cells through lymphatic vessels to the lymph nodes. As a consequence, mutant mice displayed a severe impairment in lymphocyte homing and a compromised contact hypersensitivity response. By contrast, lymphocyte rolling was increased because of loss of electrostatic repulsion by heparan sulfate."

   a. Please give a most appropriate **title/conclusion** for the above abstract (use no more than 30 words). (5 %)
   b. Please explain why the authors had to use inducible system to mutate Ext1. What problem would occur if they hadn't done that? (5 %)
   c. Based on our understanding of lymphocyte homing, why the mutant mice caused the lack of appropriate integrin-mediated adhesion? (5 %)
   d. What are **the sequential molecular events occurring on both lymphocyte and endothelial surfaces** to mediate heparan sulfate-triggered lymphocyte homing? (10 %)

---------- **Please be noted that unnecessary answers may harm your scores!!** ----------

2. An abstract from Nature Cell Biology 12, 390-399, 2010: "Recurrent chromosomal aberrations are often observed in hepatocellular carcinoma (HCC), but little is known about the functional non-coding sequences, particularly microRNAs (miRNAs), at the chromosomal breakpoints in HCC. Here we show that 22 miRNAs are often amplified or deleted in HCC. MicroRNA-151 (miR-151), a frequently amplified miRNA on 8q24.3, is correlated with intrahepatic metastasis of HCC. We further show that miR-151, which is often expressed together with its host gene FAK, encoding focal adhesion kinase, significantly increases HCC cell migration and invasion in vitro and in vivo, mainly through miR-151-5p, but not through miR-151-3p. Moreover, miR-151 exerts this function by directly targeting RhoGDIA, a putative metastasis suppressor in HCC, thus leading to the activation of Rac1, Cdc42 and Rho GTPases. In addition, miR-151 can function synergistically with FAK to enhance HCC cell motility and spreading."

   a. Please give a most appropriate **title/conclusion** for the above abstract (use no more than 30 words). (5%)

(背面仍有題目,請繼續作答)

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b. Why the authors were interested in searching the functional non-coding sequences at the ***chromosomal breakpoints*** in HCC, little of which is known? (5%)

c. FAK is the host gene of miR-151. What does ***host gene*** mean? **(5%)**

d. What are **the two possible ways** for FAK to enhance HCC cell motility and spreading? **(10%)**

---------- **Please be noted that unnecessary answers may harm your scores!!** ----------

3. Please describe the endosymbiosis hypothesis about the origin of eukaryotic cells; compare the common and different features between prokaryotes and eukaryotes. (10%)

4. Please describe the signal hypothesis and the general features of uptake targeting sequences (or signals) that control protein transportations from cytoplasm to organelles including endoplasmic reticulum, mitochondrion, nucleus, and peroxisome. (10%)

5. Please describe the meanings and biological functions of morphogen, asymmetric cell division, community effect, maternal effect genes, and zygotically acting genes. (10%)

6. Please first compare the differences between mitosis and meiosis; second describe the stages and processes of meiotic prophase I and the biological significances of meiosis. (10%)

7. Please explain the detailed processes of fertilization and the biological functions of cytosolic calcium wave; describe the processes to inhibit the polyspermy during fertilization. (10%)