

The People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research
University Center of Mila
Faculty of Natural and Life Sciences
Department of Biological and Agronomic Sciences

TD 03 – Molecular & Cellular Immunology

Exercise 1:

A 55 year old patient suffering from a severe, chronic myeloid disorder presents with hepatosplenomegaly (enlargement of the liver and spleen). Diagnostic imaging and blood work confirm that the adult bone marrow has become exhausted and can no longer meet physiological demands.

QUESTIONS:

1. Explain the underlying biochemical and physiological rationale for this organ enlargement.
2. Identify what this phenomenon is called.
3. Contrast the anatomical sites involved with normal adult hematopoiesis.

Exercise 2:

A researcher is attempting in vitro expansion of purified hematopoietic stem cells (HSCs) to maximize their yield for therapeutic applications. The researcher adds multipotent factors (GM-CSF and IL-3) to the culture medium before introducing promoting factors (SCF and IL-1).

Questions:

1. Predict the outcome of this experiment based on hierarchical cytokine sensitivity
2. Explain explain the functional roles of each factor group
3. Correct the experimental sequence.

Exercise 3:

Part 1:

A toxicological study evaluates a chemical agent that specifically degrades the extracellular matrix (ECM) proteins and disrupts stromal cell interactions within the adult bone marrow.

Questions: Predict the specific consequences of this niche breakdown on HSC self-renewal, quiescence, migration, and differentiation.

Part 2:

During embryonic and fetal development, an ischemic event selectively disrupts vascular perfusion to the primary hematopoietic organ active during the second trimester.

Questions:

1. Identify the specific anatomical site affected.
2. State the precise developmental window during which this site is normally active.
3. Evaluate where hematopoiesis would have occurred immediately prior to this stage.

Exercise 4:

Part 1:

A researcher needs to isolate pure hematopoietic stem cells (HSCs) from a bone marrow aspirate for transplantation research using flow cytometry.

Questions:

1. Identify the single most critical surface marker required for isolating human HSCs.
2. Explain the hierarchical distinction between cells bearing this marker and downstream committed precursors.
3. List the major lineage arms they eventually give rise to.

Part 2:

Under conditions of extreme systemic inflammation or immune challenge, the body must adjust blood cell production rates. However, uncontrolled proliferation of HSCs can lead to malignancies like leukemia.

Questions:

1. Identify the negative regulatory factors responsible for counterbalancing promoting factors.
2. Explain their mechanism of action.
3. Discuss how they maintain physiological homeostasis.

Part 3:

A patient with acute leukemia undergoes a bone marrow transplant. Although the donor stem cells are successfully infused, they fail to home to the bone marrow microenvironment, resulting in complete engraftment failure.

Questions: Based on the biological functions of the hematopoietic niche

1. Analyze which structural, cellular, and extracellular components of the bone marrow microenvironment must successfully interact with the incoming stem cells to ensure proper homing, self-renewal, and engraftment.