MCB 150 Problem Set  Infectious Disease

Q1. *Staphylococcus aureus* is a very common extracellular bacterial pathogen that causes a wide range of diseases ranging from strep throat to rheumatic fever and toxic shock.
A. What would be the primary **adaptive** immune response to these bacteria?

B. *S. aureus* infection can occasionally cause a systemic inflammatory response that can result in shock and organ failure. How could this bacteria cause this serious disease consequence?

Q2. Leishmania are protozoan parasites that cause skin diseases and potentially systemic infections that can be lethal. Leishmania primarily infect macrophages and live endosomally. It has been well-documented that certain strains of mice, such as BALB/c, are more susceptible to Leishmania infection whereas other strains of mice, such as C57Bl.6, are more resistant to infection.
A. Would you expect the resistant C57Bl.6 mice to mount a Th1 or Th2 response? Why would a targeted cytokine bias be beneficial in response to this parasite?

B. Propose an immune genetic difference that could help explain why BALB/c mice are more likely to mount an immune response that is less able to resolve Leishmania infection?

C. A new vaccine for humans has been developed using a recombinant fusion protein combining three antigens identified from the mouse model of Leishmania. This vaccine is a single recombinant polyprotein comprising the sequences of all three open reading frames genetically linked in tandem. The resulting molecule comprises an open reading frame that codes for a 111kDa polypeptide. Would this vaccine require an adjuvant and what type of immune response would you expect this vaccine to elicit?

Q3. Influenza virus infects the respiratory epithelial cells.
A. Before the adaptive immune response is activated which **innate** immune responses will be most effective against spreading of Influenza virus infection? List 2.

B. For resolution of Influenza virus infection the adaptive immune response is usually required, what 2 arms of the adaptive immune response are most effective at preventing spread of viral infection?

C. What immune evasion mechanism does Influenza virus have to help avoid the adaptive immune responses? Please explain.

Q4. Why are enveloped viruses susceptible to complement-mediated lysis whereas non-enveloped viruses are resistant to complement-mediated lysis?
Q5. Trypanosoma brucei are unicellular protozoan parasites which live extracellularly in your bloodstream and can cause the disease sleeping sickness. Infection with *T. brucei* is transmitted by tsetse flies.
A. If you have a systemic infection with Trypanosomes, in which **lymphoid organ** will these parasites be filtered out by phagocytic cells to get activation of the adaptive immune response? (4 pts)

B. What are **two factors** that will help determine if *T. brucei* will make a **good immunogen** (in other words that it will be seen by the adaptive immune response)?

C. What type of adaptive immune response will be **most effective** for eliminating these parasites and why?

D. Will the *T. brucei* antigens be presented by dendritic cells through the exogenous antigen processing pathway or the endogenous antigen processing pathway? **Explain your answer.**

Q6. You wish to make a vaccine against a pathogenic virus whose normal route of infection is through the gastrointestinal tract.
A. Which adaptive immune defenses might be useful against the virus after it has penetrated the lining of the intestine but before it has entered a cell?

B. Why might an inactivated vaccine prepared from killed virus and injected intramuscularly give relatively poor protection in field tests?

C. What alternative approach would you want to try to make a more effective vaccine against this pathogen? Why should it be more effective?

Q7. Poliovirus infects epithelial cells and neurons. Poliovirus infection can lead to paralysis and death. Polio is transmitted fecal-orally.
A. What type of adaptive immune response activated which secondary lymphoid tissue will help prevent poliovirus from leaving the intestines and entering the bloodstream?

B. Fill in the chart below advantage in giving the Sabin polio vaccine (live attenuated virus administered orally) or the Salk polio vaccine (killed virus injected intravenously).

<table>
<thead>
<tr>
<th>Type of Vaccine Route</th>
<th>Sabin polio vaccine</th>
<th>Salk polio vaccine</th>
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<tbody>
<tr>
<td></td>
<td>Live attenuated</td>
<td>Inactivated virus</td>
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<tr>
<td></td>
<td>Oral</td>
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<th>Advantage</th>
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