Introduction and Disclaimer

These mock examination questions span diverse disciplines and are designed for your practice in preparation for the International Research Olympiad (IRO) 2024. Endeavor to answer them to the best of your ability, utilizing this opportunity to enhance your skills and knowledge. For additional practice, it is advisable to engage in extensive reading of various papers; such efforts will contribute to a more comprehensive and nuanced understanding of the subject matter.

Try your best, and good luck! -International Research Olympiad 2024

Mock Examination Answer Key 3
Bolded answers are correct.

Paper 3: Medicine/Biomaterials

Question 1

Question: When looking at the study, the high capacity of tissue repair makes MSC-EVs a promising part of tissue regeneration therapies, especially in biomaterial construction. What reasons support this specific claim?

a.) **EVs, as an endogenetic biological agent, have innate host affinity and can deliver easy-to-deactivate and degrade substances to target cells.**

- **True, this ability of EVs is explicitly stated in the paper and is a key factor in their potential for tissue repair and biomaterial construction.**

b.) The nano-size of EVs is suitable for traveling through the circulatory system and barriers, which provides the possibility for distant delivery to promote specific organ regeneration.

- While the nano-size of EVs facilitates their distribution, the paper does not directly link this feature to their high tissue repair capacity.

c.) The nano-size of EVs is not suitable for traveling through the circulatory system and barriers, which increases and provides the possibility for distant delivery to promote specific organ regeneration.

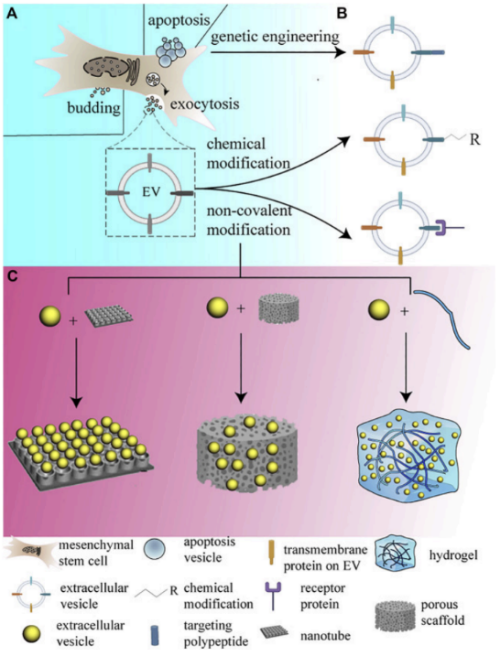
- This is incorrect; the nano-size of EVs actually enhances their ability to travel through the circulatory system, supporting their role in tissue repair.

d.) EVs cannot maintain effective concentration in the tissue nor the circulation system, and local injection is mainly limited by their retention ratio.

- This statement contradicts the premise of the question, which is about the reasons supporting the high capacity of MSC-EVs for tissue repair.

Question 2

Question: According to the study we are examining a visual in specific, and we can see that all the steps from EV secretion to the final component are shown. What can be implied about Part C given only the information in the visuals?



a.) Certain EVs can only go into specifically tailored biomaterials.

- The biomaterials in the figure are not "specifically" tailored in any way. The placement seems random.

b.) **EVs can be loaded onto different forms of biomaterials.**

- **The image shows that the EV is applied to many different porous materials with various shapes and densities.**

c.) All EVs can only go into any biomaterials as long as it's porous.

- The image does not imply that porosity is the only requirement for biomaterials to be suitable for EV loading.

d.) EVs cannot be loaded onto different forms of biomaterials, only one certain one.

- The image clearly shows a wide assortment of biomaterials the EVs can be loaded into.

Question 3

Question: As indicated by the study, MSC-EVs may function in the following way, which includes modulating the autophagic flux of recipient cells to facilitate tissue regeneration. In the context of this paper, what would best describe autophagic flux?

a.) The measure of the degradation activity of a certain pathway.

- Autophagic flux is essentially the degradation of a pathway and can in turn facilitate tissue regeneration as indicated by the paper.

b.) The measure of the variability and disturbance of a certain pathway.

- The amount of variability would not help to facilitate tissue regeneration. In some cases, it might, but not generally.

c.) **The flow of MSC-EVs to recipient cells to facilitate tissue regeneration.**

- **The flow of MSC-EVs is not what is going to facilitate tissue regeneration.**

d.) The measure of the variability and disturbance of MSC-EVs to recipient cells to facilitate tissue regeneration.

- The amount of variability and the measure of disturbance would not facilitate tissue regeneration successfully in all scenarios.

Question 4

Question: Either activation or inhibition of autophagy can be related to tissue regeneration. Adipose mesenchymal stem cell (ADMSC)-EVs rescued neurons under oxygen and sugar deprivation promoted regeneration by inhibiting autophagic flow. What is this indicative of?

a.) After someone goes through an epilepsy, the postictal state is further elongated, and the timespan is longer than what it was previously.

- Although the state is elongated, the timespan is not longer than what it was previously.

b.) After someone goes through an epilepsy, the prodrome and aura state is further expedited, and the timespan is longer than what it was previously.

- The prodrome and aura state is NOT being further expedited.

c.) After someone goes through an epilepsy, the prodrome and aura state is shortened, and the timespan isn't as long.

- The aura state is NOT shortened and this phase of epilepsy isn't associated with the context of the problem.

d.) **After someone goes through an epilepsy, the postictal state is further expedited, and the timespan isn't as long.**

- **True, the postictal state is further expedited and the timespan actually decreases a bit.**

Question 5

Question: In the studies outlined, it has been proved that EVs released from stress-induced cells are enriched with oxidatively damaged mitochondria, which can induce a burst of ROS in cardiac tissue which protects the heart through hormesis. Based on the paper, which of the following predictions is best supported?

a.) An increased spike of ROS would cause increased cell adaptation to stress or resilience, or balanced hormesis.

- An increased spike would not cause increased cell adaptation; rather, it would decrease.

b.) An increased spike of ROS would cause no change in cell adaptation to stress or resilience, resulting in unchanged hormesis.

- It would cause a change as there would be an increase in ROS which would fluctuate some components.

c.) **A burst of ROS would cause decreased cell adaptation to stress or resilience, or unbalanced hormesis.**

- **A burst would indeed decrease cell adaptation as the ROS would cause cellular components to change and decrease resilience.**

d.) A burst of ROS would cause decreased cell adaptation to stress or resilience, or balanced hormesis.

- A burst of ROS would not cause a balanced hormesis. The hormesis would be unbalanced.