EDITORIAL

Why Preclinical Imaging and What Will Happen in the Future?

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1. Preclinical Imaging: Why?

Small laboratory animals such as mice are being used to understand more about the biology of human system. This would create a setup where more information is extracted from animal models before moving into clinical research. This is referred to as preclinical studies and it should be according to the animal welfare regulations to be ethical. Currently, one of the most frequent uses of preclinical studies is for drug development.

The path of discovering/designing a molecule to developing a novel drug could take up to an average of 12 years and costs around $1 billion (USD). Preclinical phase is a major step on this path and is the part where scientists perform additional studies on their molecules before moving the drug into clinical studies. Preclinical studies consist of anything ranging from observing efficacy, dosing strategy, safety and toxicological studies, and pharmacokinetics and pharmacodynamics. Pharmacodynamics consists of any studies performed to understand the relationship between the amount of drug in the body and its biological effect. In summary, this means what does the drug do to the body and how potent and efficacious the drug is? In pharmacokinetics, we are interested to identify the effect of body on the drug. Therefore, we would be interested in knowing the absorption, distribution, metabolism, and excretion of the novel drug. In order to ensure reliability and consistency all of the preclinical results should be complied with good laboratory practice and are required to be submitted to an organization such as the Food and Drug Administration (FDA) before filing for approval of an investigational new drug.

Addressing all of the above questions requires time and money but with the rise of cutting-edge technologies such as preclinical imaging, the advancement of preclinical studies has excelled. This is due to being able to see in real-time and the same preclinical model the majority of parameters needed to be identified for the preclinical phase of drug development.

Currently, there are many imaging technologies available to us that could extract the information from inside of the animal. The concept behind imaging technologies is to detect energy and energy differences from inside of the animal. This means that the subject being imaged should be under or inside the imaging device. Imaging procedures can be categorised into invasive and non-invasive imaging. The most known invasive imaging technology is intravital multiphoton imaging where the area being imaged usually is surgically exposed and the imaging objectives are

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placed on the tissue of the interest and imaged while the animal usually being anesthetised. With regard to non-invasive imaging technologies, it consists of Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), Magnetic Resonance Imaging (MRI), Ultrasound and Optical Imaging which itself is comprised of Fluorescence Imaging and Bioluminescent Imaging.

2. Preclinical Imaging: What Will Happen in the Future?

There are numerous preclinical imaging studies carried out and more are in progress. This field is continuously being studied and progressed exponentially. These include advancements in the production of various novel and specific molecular imaging agents and theranostic agents. Also, various groups are focused on the optimisation of imaging modalities. However, there would be few areas that the authors are forecasting that will be excelled and more frequently being used in the future in this multidisciplinary field. The first aspect that we believe will be progressed is the increase of diversity of preclinical applications. Currently, imaging is mostly being used in neurology, cancer, and cardiovascular studies. However, we believe this pattern would be changed and many more branches of sciences and engineering would be taking advantage of preclinical imaging. The other area that we believe will be developed in the future is the linking of artificial intelligence and big data with preclinical imaging. This is currently being used and studied for image processing and analysis. However, we believe this would be also progressed for developing a customised and personalised imaging acquisition protocol. This could refine the amount of data being extracted from a single imaging study as well as reducing the cost and time usage and stress caused to the animal. The third area that we predict will be progressed is the concept of imaging non-anesthetised animals. Currently, there are scientific groups that are working on this and have developed products that mostly require a detector to be invasively attached and fixed to the animal. However, we believe with the advancement of technology we should be expecting the development of many more devices where non-anaesthetised non-invasive imaging would be the most frequent type of preclinical imaging utilised. However, these are just predictions and we should see what future has in store for us.