Small-molecule Drugs and Their Future

AUSTIN, TEXAS, UNITED STATES, December 3, 2020 /EINPresswire.com/ -- Small-molecule (smolecule) drugs are defined as compounds with a low molecular weight that are capable of modulating biochemical processes to diagnose, treat, or prevent diseases. Small-molecule drugs include aspirin, diphenhydramine, and other molecules that we typically have in our medicine cabinets. Pharmacology usually restricts the term "small-molecule" to molecules that bind specific biological macromolecules and act as an effector, altering the activity or function of the target. Small molecules can have a variety of biological functions or applications, serving as cell signaling molecules, drugs in medicine, pesticides in farming, and in many other roles.

Small-molecule drugs, including natural products, have been the pillars of traditional medicine and played an important role in shaping the world we live in. A classic example is the wonder drug penicillin, which successfully reduced the death rate by bacterial-related pneumonia to less than 1% during World War II. Moreover, small molecules have been some of the biggest blockbusters in the history of the pharmaceutical industry. For example, atorvastatin (Lipitor) generated at least 9 billion dollars per year in revenue for Pfizer during its patent life from 2003–2011. Despite the emergence of many biologics, small-molecule drugs still remain highly prevalent on the latest WHO Model List of Essential Medicines in 2017.

The upper molecular-weight limit for a small molecule is approximately 900 Daltons, which allows for the possibility to rapidly diffuse across cell membranes so that it can reach intracellular sites of action. This molecular weight cutoff is also a necessary but insufficient condition for oral bioavailability as it allows for transcellular transport through intestinal epithelial cells. In addition to intestinal permeability, the molecule must also possess a reasonably rapid rate of dissolution into the water and adequate water solubility, and moderate to low first-pass metabolism.

To healthcare providers and patients, small-molecule drugs are attractive for several reasons. First, because of their relatively low molecular weight and simple chemical structures, their pharmacokinetics and pharmacodynamics are normally more predictable than those of biologics, which often lead to simpler dosing protocols. Second, the development of small-molecule drugs often involves simpler manufacturing, characterizing, and regulatory processes. Additionally, many small molecules are highly stable and orally bioavailable, which further enhances patient compliance. Ultimately, because of all these reasons, small-molecule drugs are naturally relatively more affordable for patients and reimbursement bodies.

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