

Measuring Membranes: Quantifying Cortisone Interactions through X-Ray Diffraction

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Currently, drug interactions are explained by the lock-and-key model which offers a crude approach to quantifying the efficacy of drugs based on receptor communications. There is no gradient of effect provided by the current system, offering only a yes or no answer, which results in an array of unexplained side effects. Lipid membranes act as an important biological interface which are found to conform structurally to drugs. Using X-ray diffraction (XRD), these changes in membrane structure can be used to quantify a drug's efficacy at the angstrom level. Cortisone is an injected anti-inflammatory drug which is known to cause unexplained pain as a side-effect. XRD was used with synthetic membranes to identify cortisone localization, orientation, and changes in membrane dynamics. The large sterol-based drug was found to localize in the phosphate heads and not interact with the hydrophobic tails and the according orientation was found. The membrane width decreased as cortisone concentration increases, and the solubility limit was reached at 35mol% at which point crystallized cortisone was observed upon the bilayer. This is a novel finding and can potentially explain the cause of side effects, as it suggests membranes become more disorganized and induce cortisone clumping. Synergistic effects were explored by analyzing membranes prepared with other drugs. XRD suggests a drug-drug interaction where ibuprofen prevents cortisone's entry into the bilayer which cannot be observed with traditional models. By measuring the effects with lipid membranes, a more quantified and holistic analysis of drug interactions is developed for cortisone.

Awards Won:

Spectroscopy Society of Pittsburgh: Honorable Mention