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Perspective

Practical Issues in Therapeutic Drug Monitoring

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DESCRIPTION

Ideally, high-quality drug trials should be completed within a clinically reasonable time frame. In a large laboratory of chemical pathology, staffed with highly trained scientists and equipped with state-of-the-art automated analyzers, many clinicians expect accurate results. Therefore, analytical laboratories need to ensure that procedures are in place to retrieve the missing information from drug test requests that may be necessary for proper clinical interpretation of the results. Dosing planning, blood draw timing, and accuracy, sensitivity, and specificity of each assay are regularly documented and evaluated. Whenever possible, test performance should be evaluated using an external quality assurance program with a short duration of results, comprehensive feedback on test performance, and a large subscriber base. Test results should be available promptly, preferably within 24 hours of sample receipt, as the most important use of measurement is the diagnosis of toxicity when dose adjustment and rapid determination are required. In fact, there is evidence that field measurements of antiepileptic drugs have a direct impact on clinical decision making and outcomes.

The most important consideration in interpreting plasma drug levels is to tailor treatment to the patient's physiological needs. In doing so, the clinician should consider not only the concentration, but also other clinical features that may affect the relationship between concentration and clinical efficacy. Therefore, it is important for clinicians to know how to interpret plasma concentration results in the context of the patient's condition, rather than making pre-determined guesses about what the measurements mean. Patient demographics are important to take into account the contribution of age, medical condition, race, and other variables to changes between subjects in pharmacokinetics and pharmacodynamics. Clinicians requesting drug tests need to effectively communicate these details to members of the TDM team. Once a decision has been made to monitor the concentration of a therapeutic agent, it is important to take a biological sample to provide clinically meaningful measurements. Timely collection of blood samples is required for proper pharmacokinetic assessment. In order to properly interpret plasma concentrations, the TDM team should be notified when plasma samples are taken in relation to the last dose given and when drug therapy is initiated. Like digoxin, if plasma samples are taken before the drug's tissue distribution is complete, plasma concentrations will be higher than expected based on dose and response. Peak plasma levels help assesses the dose of antibiotics used to treat severe life-threatening infections.

Serum levels of many drugs peak 1-2 hours after oral administration, but factors such as delayed or delayed absorption can significantly delay the peak serum levels. Therefore, with a few exceptions, plasma samples should be collected when determining normal plasma drug concentrations in the trough, or just prior to the next dose (Css min; minimum steady-state concentration). The levels are less likely to be affected by absorption and distribution issues. Repeated doses of the drug to the patient cause the drug and its metabolites to accumulate in the body. Ultimately, equilibrium or "steady state" is reached when the amount given is equal to the amount excreted. The time it takes to reach this steady state depends only on the half-life of the drug. After half-life, more than 95% of the drug accumulated and reached steady state for practical purposes. Plasma concentrations can be measured before reaching this steady state, but the timing of sample collection must be considered when interpreting the results. Blood samples should be collected as soon as the drug concentration reaches steady state, for example after at least 5 half-lives at the current dose. Values approaching steady state can be reached early when the loading is administered. However, as in the case of amiodarone and perhexylin, half-life before reaching steady state to ensure that subjects with metabolic or renal excretion disorders are not at risk of developing toxicity at the prescribed starting dose. Long drug needs to be monitored. Plasma levels should be monitored as soon as possible if drug toxicity is suspected. Also, inadequate treatment management, such as rapid atrial fibrillation, may require an immediate assay because the loading may be useful. Information about the dosing regimen (dose and duration) is essential for interpreting the results. Blood or plasma concentrations change during dosing intervals and it is necessary to know the timing of blood draws relative to the timing of dosing to allow meaningful interpretation.

Plasma concentration information is useful for a number of drugs in clinical practice. Several criteria must be met for plasma concentrations to be useful. Although the therapeutic or toxic effects of drugs can be easily measured directly, plasma drug concentrations provide little additional information about drug effects. On the other hand, if it is difficult to measure the therapeutic effect of a drug, plasma drug measurement helps to

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adjust drug dosage within the appropriate therapeutic range. Measurement of drug plasma concentrations is useless if it does not provide interpretable information about the patient's therapeutic or toxicological status; for example, if digoxin levels are below therapeutic in patients with compensated heart failure and sinus rhythm, digoxin can be withdrawn without fear of worsening heart failure. Additional criteria included a low toxicity rate and the presence of active metabolites. Even when drugs meet these criteria, interpretation of drug plasma concentrations may be difficult due to the presence of distinct therapeutically active or toxic metabolites. If active metabolites are produced, the parent drug and metabolites should be measured to provide a comprehensive picture of the relationship between the total plasma concentrations of the active compounds and the efficacy. This is often not possible with routine monitoring, which limits the usefulness of measuring plasma concentrations of, for example, procainamide, which is metabolized to n-acetyl-procainamide (acecainide), which has anti-inflammatory activity. Drug interactions, electrolyte balance, acid-base balance, age, bacterial resistance, and protein binding are factors that alter the effect of a parent drug on certain plasma drug concentrations if the total concentration of the drug is measured.