

# Therapeutic drug monitoring — a vital pharmacy role

Therapeutic drug monitoring (TDM) is important for the optimal dosing of a wide range of drugs. This article introduces the principles of TDM and is followed by a case study. By David Jones.

**T**herapeutic drug monitoring (TDM) involves tailoring a dose regimen to an individual patient, by maintaining plasma or blood concentrations within a particular range (the therapeutic range).

To achieve optimal drug therapy, three objectives should be met:

- To attain the desired pharmacological effect of the drug
- To reach this maximal effect in the shortest possible time
- To decrease the risk of toxicity

TDM is important for a wide range of drugs including aminoglycoside antibiotics (e.g. gentamicin), immunosuppressants, digoxin, vancomycin, theophylline, methotrexate, tricyclic antidepressants, lithium and antiepileptics (e.g. phenytoin — see box).

TDM is useful in drugs:

- With a narrow therapeutic index
- Which are highly protein-bound
- Which are liable to interact
- In which the metabolite might be toxic

It is also useful in cases where:

- The usual dose of a drug does not produce expected results
- Clinical benefit is related to serum drug concentrations but is difficult to assess
- Clinical signs of toxicity may be difficult to recognise
- Social habits may affect the handling of a drug (e.g. smoking, alcohol)
- Patients have other co-morbidities which can alter pharmacokinetic parameters (e.g. congestive cardiac failure, renal failure)

Other uses of TDM include determining patient compliance and assessing inter-patient variability.

## Clinical pharmacists in TDM

An effective TDM process requires a collaborative, multidisciplinary approach with input from doctors, nurses and clinical pharmacists.

Clinical pharmacists have a vital role to play in TDM, offering advice to medical and nursing staff about the use of TDM, dose calculations and interpretation of the results obtained. This could involve



Drug plasma concentrations should be within the therapeutic range

recommending an appropriate drug regimen taking into account dose, dosage interval and route, based on a number of patient-specific factors such as age, weight, and renal function.

Pharmacists can also use their expertise to examine possible causes of unusual TDM results, which may arise from problems with bioavailability, drug interactions, non-compliance or medication errors.

Some pharmacists find TDM and pharmacokinetics challenging. There are a number of reasons for this including a lack of confidence (especially if TDM is not used on a daily basis), being unsure about which drugs require specific monitoring and the methods used for each drug, a lack of understanding about other factors which can affect the kinetics of a particular drug, or simply constraints on their time. Nevertheless, input from pharmacists is important in TDM, as illustrated by the case study on p172.

*David Jones is specialist clinical pharmacist at Northumbria Healthcare NHS Foundation Trust.*

A case study on p172 illustrates the role of the clinical pharmacist in therapeutic drug monitoring of a patient taking phenytoin, with a number of co-morbidities.

## Therapeutic drug monitoring of phenytoin

Phenytoin is an example of a drug for which therapeutic drug monitoring is essential. It is most commonly used as an antiepileptic, but is also used to treat trigeminal neuralgia and certain types of cardiac arrhythmia.

The therapeutic range for phenytoin is 10–20mg/L. Phenytoin toxicity can present as nystagmus, vertigo, diplopia, ataxia, drowsiness, and speech disturbances.

Dose calculation for phenytoin must take into account the patient's serum albumin status and renal function, as well as the non-linear, zero order pharmacokinetics of the drug (see p172).

Different salts of phenytoin are used in different preparations of the drug, and this must be taken into account when, for example, switching a patient's dose formulation from capsules to a suspension. Phenytoin capsules and injection contain the sodium salt of phenytoin ( $F$  [bioavailability] = 0.92), whereas the chewable tablets and suspension contain the base form ( $F=1$ ).