A better acetylcysteine prescription

Uttamal M. Chouhan, Elisabeth J. Dubourg and Linda Dodd discuss the complicated regimen of acetylcysteine administration in paracetamol overdose and how two prescribing aids can reduce the likelihood of both prescribing and administration errors.

It is estimated that there are about 70,000 cases of paracetamol overdose in Britain each year. Deaths resulting from paracetamol overdose have been falling since the restriction of sales of larger tablet pack sizes in 1998 but, in England and Wales, there are still around 100 deaths every year resulting from the ingestion of paracetamol alone or paracetamol-containing preparations.

Since 1981 the BNF has recommended acetylcysteine as the treatment of choice in the UK for the management of paracetamol overdose. It is be administered as an intravenous infusion as follows:

- First dose: 150mg/kg over 15 minutes in 200ml of 5 per cent glucose
- Second dose: 50mg/kg over four hours in 500ml of 5 per cent glucose
- Third dose: 100mg/kg over 16 hours in 1L of 5 per cent glucose
- The last dose may be repeated according to clinical needs

Considerable thought from the prescriber is needed when writing the prescription and then from the nurse who prepares and administers the infusion. The prescriber needs to specify the actual acetylcysteine dose (in grams), fluid regimen and associated infusion fluids. The nurse needs to convert the dose (in grams), fluid regimen and associated infusion settings to specify the actual acetylcysteine dose (in millilitres) into a volume (ml) of injection — the basis for such a complicated regimen, initially reported in 1977, is not known but the clinical evidence demonstrating its benefit is well established. With such a complex regimen, however, there are many opportunities for error when writing, preparing and administering a prescription for acetylcysteine.

An intravenous infusion of acetylcysteine is prescribed for patients with significant paracetamol poisoning.

Errors in prescribing of acetylcysteine leading to adverse events have been described in 19 cases. In five of these cases a 10-fold increase in the dose of acetylcysteine was administered. The clinical features of overdose with acetylcysteine are similar to the signs and symptoms of anaphylaxis, which can occur during administration of normal doses. Two of these five patients died but it is not known whether the cause of death was due to acetylcysteine overdose or as a consequence of severe paracetamol overdose.

Recently two cases have been reported where patients received only 10 per cent of the acetylcysteine dose due to a prescribing error. Sub-therapeutic doses led to prolonged hospital stays for one patient required admission to the intensive care unit. The authors of these case reports went on to recommend that doctors should routinely use the information from the table provided in the package insert to write the prescription for acetylcysteine in cases of paracetamol overdose. However, this may not be feasible in practice since the prescribing is likely to be undertaken in a place where there is restricted access to the product because it is stored in a locked cupboard.

Preprinted labels

Preprinted labels for the use of acetylcysteine infusion were developed and introduced to Glan Clwyd Hospital's pharmacy in late 2002 to alleviate prescription writing problems, to minimise the risk of delays in initiating treatment and improve the accuracy of preparation and administration. Labels are available in all areas where acetylcysteine is stocked and are widely publicised within medical admission wards and the accident and emergency department. These labels are self-adhesive and can be attached to a patient's main drug treatment chart.

To complete the label, the prescriber inserts the date of the prescription, the dose in milligrams of acetylcysteine (which can be read from the table in the trust medicines guide based on the patient's weight) and his or her signature. The nurse completes the rest of the label.

Electronic prescribing

A computer program was developed following an audit on the use of preprinted labels which showed some improvement in completion of acetylcysteine prescriptions compared with handwritten ones but completion was still not satisfactory. The program requires the prescriber to type in the patient's name, weight (in kg) and hospital number. The software then calculates the required dose and prints out the acetylcysteine prescription (in the same format as the treatment chart used in the hospital), which the prescriber then needs to sign and date. Nursing staff then need to complete the time that administration of the infusion was started and sign the prescription. This software has been installed on Glan Clwyd Hospital's intranet and is readily available to medical staff.

This article compares three processes for writing acetylcysteine prescriptions that have been implemented at Glan Clwyd Hospital, ie, no formal aid, use of a preprinted label or use of an electronic prescription, by looking retrospectively at data from two audits.
The audits
The aim of the audits was to investigate the information provided on acetylcysteine prescriptions that were handwritten, created using adhesive labels and created by electronic means and whether use of the labels or electronic prescriptions has had an impact on reducing clinical incidents.

R retrospective data were collected from 1 August 2004 to 5 January 2005 and from 1 May 2006 to 30 September 2006 for patients who had been admitted to Glan Clwyd Hospital with suspected paracetamol overdose. Patients for inclusion were identified as those with a plasma paracetamol level of greater than 0.1mmol/L as recorded by the hospital’s chemical pathology laboratory. After patient identification, data were extracted from the patient’s medical records and prescription charts. Data retrieved included whether the prescription was handwritten, whether an adhesive label was used or an electronic prescription used, the date of prescription, volume in ml of acetylcysteine injection for each dose and the doctor’s signature.

A total of 205 patients were identified with a plasma paracetamol concentration greater than 0.1mmol/L over the two audits. Of these, 73 were treated with intravenous acetylcysteine. To verify the two audits, the dose of acetylcysteine was stated in 13 of 21 cases (62 per cent) where handwritten prescriptions were used, 23 of 28 cases (82 per cent) where adhesive labels were used and 100 per cent where electronic prescriptions were generated. Infusion details were incorrect on two of the handwritten prescriptions although they were correct on all prescriptions generated using either adhesive labels or electronic software.

Discussion
The results of the first audit were presented in early 2005 to medical staff including those in the accident and emergency department. The physicians’ most practical suggestion, to increase the wider use of preprinted labels, was to put them inside boxes of acetylcysteine injection before they are distributed to wards. This suggestion was implemented.

The electronic prescription was introduced to the hospital in April 2006 and the second audit performed after this.

Analysing data from both audits identified that failure to complete a prescription was most often due to failure to insert the date of the prescription or signature of the prescriber. This occurred most when preprinted labels or electronic prescriptions were used. Another frequent omission made when using labels was dosage information. The prescriber often just wrote the weight of the patient on the label. It is then assumed that nursing staff had to consult either a doctor or the trust’s medicines guide to obtain the required volume of acetylcysteine injection in order to prepare and administer it.

A strategy adopted to increase the use of the electronic prescription was to publicise its availability at the induction of new junior medical staff and to nursing staff. It is important to raise the awareness of nursing staff during their training in intravenous drug administration of the correct use of diluents and infusion rates for acetylcysteine specifically.

Greatest improvement in prescribing has been shown with the introduction of the electronic prescription because it gives all the details on dose, infusion volumes and infusion rates. An electronic prescription for paediatric patients has also been developed but to date no paediatric patient had been admitted with paracetamol overdose for the effects of this software to be evaluated.

The findings of both audits were presented to all grades of medical staff and they made a unanimous decision to use the electronic prescribing tool as the preferred choice for writing a prescription for acetylcysteine in paracetamol overdose. The trust’s clinical governance committee has also endorsed this choice.

The merits of electronic prescribing have been reviewed recently and its benefit in reducing errors in calculations has been well demonstrated, eg, in haematology, oncology and paediatrics where drug calculations are routinely performed.

There are advantages with the electronic prescription. The doctor’s version of the acetylcysteine prescription, ie, 24-hour availability of the calculator on the hospital intranet and only three data entries required to generate the prescription. Other obvious advantages compared with handwritten prescriptions include legibility and ease of completion.

Patients admitted with suspected paracetamol overdose have to be treated with the same care and respect10 as other patients to minimise the risk of prescription-related errors. The introduction of pragmatic solutions in this audit show that improvement in the completion and accuracy of prescriptions and the standardisation of acetylcysteine in the management of paracetamol overdose is possible.

Although this article addresses how to improve the prescription writing of acetylcysteine infusions it has also shown that there can be substantial variation in the doses of acetylcysteine administered to patients due to preparation.11–13 In order to reduce errors related to preparation the pharmacy department at Glan Clwyd Hospital has considered preparing standardised acetylcysteine intravenous infusion bags so that they are available ready to use.

Since the introduction of adhesive labels and the electronic prescription, only one clinical incident related to acetylcysteine prescription writing was reported between June 2004 and October 2006 and this related to an adhesive label with no dose stated. There has been a reduction in handwritten prescriptions in the second audit in comparison with the first (3 versus 18).

The one-stop electronic prescribing tool assists medical staff to prescribe safely and gives nursing staff all the practical information necessary to prepare and administer the acetylcysteine infusion. It is in keeping with the National Patient Safety Agency alert on promoting the safer use of injectable medicines.14

Conclusion
Learning from clinical incidents and introducing changes to bring about improvement in prescribing of acetylcysteine have taken considerable time but are feasible.

Using clinical incidents to educate medical staff on how to prescribe acetylcysteine correctly and then introducing the adhesive label brought about some improvements.

The biggest improvement in numbers of correct prescriptions was seen when electronic prescribing of acetylcysteine was introduced. Electronic prescribing is now the recommended method but labels remain in circulation because not every intranet terminal is connected to a printer and also as a fail back in case of IT failure. The dosing table is still included in the trust medicines guide in case there is an IT failure or in the event of no preprinted adhesive labels being available.

References

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