Neonatal and Paediatric Pharmacists Group, 13th Annual Conference

The 13th Annual Conference of the NPPG was held in Bournemouth in November 2007 and was attended by 178 delegates. Round table discussions highlighted topical areas in paediatric clinical pharmacy and gave delegates an opportunity to share experiences and discuss problems. David Webb, Principal Pharmaceutical Officer from the Department of Health gave a key note address, describing new possibilities in paediatric pharmacy professional practice. An informative update on the management of hypertension in infants and children was delivered by Dr Rodney Gilbert, Consultant Paediatric Nephrologist at Southampton University Hospitals Trust.

There were six oral presentations and 12 poster presentations which are listed below. Jackie Wilkinson, Senior Pharmacist, Aseptic Services, Wrexham Maelor Hospital received the Special Products prize for the best first time oral presenter. Delegates enjoyed opportunities to attend workshops providing updates in various clinical aspects of paediatric patient care. Simon Keady, Lead Divisional Clinical Pharmacist at UCLH NHS Foundation Trust, London delivered a presentation describing his team's work on the use of medicines in school; perspectives of young people and their parents. This work had been funded by an award from ManMed Pharmaceuticals.

The conference was concluded by an excellent talk by Dr Jo Walker, Consultant Paediatrician, Portsmouth Hospitals NHS Trust who gave a comprehensive, entertaining and highly informative discussion of current topics in endocrinology.

O1
Clonidine for the treatment of paroxysmal autonomic instability with dystonia following traumatic brain injury

S L Dunne

Associate Care Group Pharmacist for Child Health, Southampton University Hospitals NHS Trust, Southampton, UK

Background: As a tertiary centre for paediatric neurology, Southampton accepts referrals from across the region. A proportion of these referrals are patients that have suffered severe brain injury. Consistent themes emerged in two of the cases admitted over the last year. Both patients developed symptoms of hypertension, hyperthermia, tachycardia, tachypnoea, diaphoresis, extensor posturing and agitation; a syndrome which has been described in the literature, as Paroxysmal Autonomic Instability with Dystonia (PAID).

Objective: To illustrate how high dose clonidine has been used, with good effect, for the treatment of PAID.

Methods: Two, 14 year old male, patients who presented with severe brain injury and were diagnosed with PAID are described. The causes of injury were near drowning and a road traffic collision (pedestrian versus car).

Results: Patient 1 – despite dose titration with an ace inhibitor and a calcium channel blocker, the only medicine that controlled the patient's symptoms proved to be high doses clonidine of up to 800 microg every two hours (recorded blood pressure was 142/94 before administration of this dose and 126/75 post dose). Observations, including four hourly blood pressures, were recorded during treatment and more frequently after a change in the dose. When weaning the clonidine, by administering the same dose at a decreased frequency rebound hypertension occurred. Thus, clonidine was weaned very slowly by reducing the dose and maintaining the frequency. During an acute episode of PAID, the patient had a heart rate of 100 bpm, a respiratory rate of 24 breaths/min and a blood pressure 170/111.

Patient 2 – high dose clonidine treatment was started early with a similar outcome following the experience from the first patient.

Conclusion: The diagnostic criteria for PAID syndrome has been proposed as severe brain injury accompanied by a temperature of at least 38.5°C, pulse of ≥130 bpm, a respiratory rate of ≥140 breaths/min, agitation, diaphoresis and dystonia. The duration is at least one episode per day for at least three days. It is important when considering the diagnosis of PAID that other possible conditions, warranting different treatments, are excluded.

It is thought that the features of PAID can be explained by dysfunction of the autonomic centres in the brain, mainly the thalamus and the hypothalamus. Another theory believed to be responsible for the hypertension, is the cortically provoked release of adrenomedullary catecholamines. Other pharmacological agents previously used in an attempt to treat PAID, are morphine and non-selective β-blockers. Both have proved less favourable treatment options since opiate withdrawal may provoke signs of PAID and β-blockers, although useful for treating hypertension, do not affect cholinergic signs (e.g. diaphoresis). Clonidine, an α_2-adrenergic agonist, has three actions; it reduces blood pressure, stabilises behaviour and sedates.

Increasing awareness of this syndrome and its treatment with clonidine, will allow early intervention, decrease stress and anxiety for the patient/carer and above all prevent a hypertensive or hyperthermic encephalopathy.

Reference

1. Blackman J, Patrick P, Buck M et al. Paroxysmal autonomic instability with dystonia after brain injury. Arch Neurol 2004;61:321-328.

O2
An audit of post-operative pain management in newborn gastroschisis patients illustrated with simulated plasma morphine concentrations

J G Holler, E H Bergene

Trondheim Hospital Pharmacy, Trondheim, Norway

Objective: Gastroschisis is a birth defect where the intestine protrudes through an opening in the abdominal wall. The incidence has increased, especially for babies of young mothers, for the past decades. Surgical correction is performed within the first few hours after birth. The Neonatal Intensive Care Unit (NICU) at St.Olavs Hospital has post-operative pain management procedures which evaluate neonatal pain on separate pain charts. An audit of post-operative pain management for children born with gastroschisis was initiated to compare the recorded use of paracetamol and morphine treatments to the established procedure.

Methods: The study included 12 of the 14 gastroschisis patients born between January 2006 and April 2007. Treatments with rectal paracetamol and IV morphine from the pain charts were recorded. These were compared with the medical charts. The individual plasma morphine concentrations were estimated using first order elimination/distribution kinetics. The values used for the volume of distribution (2.8 l/kg) and half-life (9 h) were estimated values from references.

Results: Eleven of 12 patients had pain charts. All patients received both paracetamol and morphine. There was no correlation between scores on the pain charts and pharmacological interventions. Fifty-one pain interventions were recorded in the pain charts, 39 of these were pharmacological; 18 of 51 interventions were associated with an intervention indicating pain score. The remaining 33 interventions were either documented as prophylaxis before a procedure or not commented. Comparing pain charts with the medical charts revealed an additional 31 morphine boluses which were not documented in the pain charts. These were all explained by the nurses to be prophylactic. Eleven of 12 patients received morphine infusions. Eight of these were initiated without a bolus dose.

Five patients received five or more repeated morphine boluses within a 24 h period in addition to a continuous morphine infusion, potentially creating very high plasma concentrations.

Four treatments of rectal paracetamol were initiated at the same time as morphine. Two were initiated 0.5–1 h after morphine and seven initiated 3.5–96 h after the start of morphine treatment. Nine of 12 patients received an accumulated daily dose of paracetamol which was higher than the maximal recommended dose in the procedure (>60 mg/kg/day). Seven of these received the high dose >48 h.

Conclusion: Even though a correlation between plasma morphine concentration and effect has not been shown in neonates, the simulations were helpful in illustrating the effect of not giving a loading dose and repeatedly giving bolus doses. They indicate a range from potentially sub therapeutic to potential toxic plasma morphine concentrations. The procedure lacks time intervals for bolus doses which could be considered for future revisions. A more individualised paracetamol treatment can be improved by manufacturing a 45 mg suppository in addition to the existing 30 mg and 60 mg.

O3
Review of dornase alfa use for suspected airway plugs

J L Hood, S Colthurst, S Arenas-Lopez, A Durward

Evelina Children's Hospital (ECH), London, UK

Objectives: Assess the use of Dornase Alfa (rhDNase) on PICU and other paediatric wards.

Compare practice against formulary recommendations[1].

Methods: Patients prescribed rhDNase from April 2006–07 were retrospectively identified from pharmacy dispensing records. Data was collected from medical notes, including indication, dose, route of administration, ward location and time to physiotherapy.

Results: Twenty patients, median age 5.5 years, received rhDNase for suspected airway plugs.

ΠΙΧΥ prescribed rhDNase in nine patients (45%):

Indication: 44% (4/9) patients received rhDNase for mucous plugs secondary to acute severe asthma resistant to conventional therapies, 11% (1/9) secondary to bronchitis, 11% (1/9) secondary to lower respiratory chest infection, 22% (2/9) patients secondary to pneumothoraces and 11% (1/9) patient secondary to sickle cell chest crisis.

Dose: All patients received the recommended dose.

Route: 66% (6/9) patients were ventilated and received rhDNase via ETT, 33% (3/9) via nebuliser.

Physiotherapy: 33% (3/9) of physiotherapy sessions were within recommended time.

Οτηερ αρεασ prescribed 55% (11/20) of nebulised rhDNase:

Indication: 45% (5/11) patients were prescribed rhDNase for suspected airway plugs secondary to acute severe asthma, 18% (2/11) patients secondary to viral bronchiolitis and 36% (4/11) patients secondary to lower respiratory chest infections.

Dose: All doses were as per formulary.

Physiotherapy: Recommended times were not followed.

Conclusions: Increased viscosity of sputum in bacterial mucous plugs is caused by excess extra cellular deoxyribonucleic acid (DNA) and the migration and death of neutrophils, rhDNase breaks down plugs facilitating excretion of sputum. Current practice is based on limited evidence for use of rhDNase via ETT in ventilated patients with acute severe asthma, secondary to mucous plugs. In viral bronchiolitis a large number of neutrophils are not present within sputum; therefore rHDNase should not be recommended[2].

On administration, rhDNase does not disperse well therefore relies on aggressive physiotherapy. In Cystic Fibrosis patients rhDNase is nebulised, the recommended time to physiotherapy is one hour post inhalation. There's no evidence to suggest best time for physiotherapy post nebulised dose in airway plugs; however via ETT patients should receive physiotherapy immediately post instillation.

Current use of rhDNase does not reflect the formulary recommendations. Use started in PICU and a small trend of encouraging results led to its use expanding across other paediatric areas and diseases worsened by mucous plugging with no clear evidence.

RhDNase is an expensive therapy, our small clinical experience on PICU so far is encouraging. Further research is needed on route of administration equivalence (ETT versus nebulised) and time to physiotherapy. The guidelines need to be reviewed to reflect practice and evidence. It would be essential to audit appropriateness and success of therapy across multi centres.

References

1. Guy's and St Thomas', King's College and University of Lewisham Hospitals, Paediatric Formulary, seventh edition, GSTFT, London, 2005.
2. Patel A, Harrison E, Durward A et al. Intratracheal recombinant human deoxyribonuclease in acute life-threatening asthma refractory to conventional treatment. Br J Anaesth 2000;84:505-7.

O4
Reducing risks: a new protocol for the management of paediatric diabetic ketoacidosis (DKA)

J Wilkinson, S Monk

Aseptic Services Unit, Pharmacy, Wrexham Maelor Hospital, Wrexham, North Wales, UK

Objectives: Management of paediatric DKA is complex, involving several infusions of varying concentrations of glucose and saline, plus potassium and insulin. Requirements are determined by a multistage calculation

process and change rapidly, in line with a fast changing biochemical picture. Speed is essential; risks of delay and error are high. Our existing practice generated urgent unpredictable requests for various infusion formulations, which were manufactured on an ad hoc basis in our aseptic unit during working hours, or on the ward out of hours, and could, particularly in the latter circumstance, result in risks and delays in treatment provision. We therefore decided that rationalisation was necessary.

The aims were:

To devise a new protocol optimising adherence to current NPSA guidance[1,2] and best-evidenced DKA practice[3,4].

To formulate a range of infusions which would remove the need to prepare any product on the ward and therefore reduce risks associated with this practice.

To facilitate easy, minimum-risk prescribing.

To facilitate variation within defined limits of the fluid volume, glucose, electrolyte and insulin which could be administered to the whole spectrum of paediatric patients, using the minimum of infusion container changes.

Methods: Literature searches and surveys of other hospitals did not provide solutions to our problem. The range of potentially required fluids to meet all needs was vast, and beyond practical stockholding of a children's ward. Moreover, guidance on potassium appeared to be based on what was commercially available, rather than what was clinically optimal. We therefore conceived a new approach involving the co-administration of an in-house pharmacy prepared potassium infusion, together with the appropriate crystalloid infusion. Each infusion would be independent and the rate of each could be varied to achieve a very wide range of concentrations of glucose and electrolytes. We also designed support documentation.

Results: The writing of the protocol, development of supporting products and training of relevant staff was completed in February 2007 and was first used in March 2007. The protocol includes:

A small range of standard crystalloid infusion solutions which are either purchased or in-house prepared, plus potassium and insulin infusions (presented in syringes).

An algorithm for calculation of individualised patient infusions, based on patient weight, biochemical data and state of hydration using the range of standard solutions.

A user-friendly set of calculation and fluid administration charts which, with training, are easy to use and reduce the risks of calculation error from the prescribing process.

A purpose designed prescription chart specifically for use with this protocol.

Conclusion: We believe that the development of this new protocol has improved our management of paediatric patients who are admitted with DKA by:

Reducing risks associated with calculation errors and ward preparation of potassium infusions.

Entirely eliminating delays in sourcing required infusions.

Providing a standardised yet very flexible, straightforward protocol for their management.

References

1. National Patient Safety Agency. PSA 01. 23 July 2002.
2. National Patient Safety Agency. PSA 20. 28 March 2007.
3. NICE (National Institute of Clinical Excellence). Clinical Guideline 15. July 2004.
4. Edge JA. BSPED Recommended DKA Guidelines. Oxford, February 2004

O5
Methyl paraben, usage of preservatives in drugs for premature neonates

Per Nydert, Manar Ali

Karolinska University Hospital Pharmacy Huddinge, Stockholm, Sweden

Objective: To show whether or not neonates are exposed to parabens at a level that exceeds the acceptable daily intake (ADI) established for adults[1].

Methods: A retrospective study was made at the neonatal unit, Karolinska University Hospital Huddinge. All premature neonate patient information during two months were collected with regards to gender, gestation age (weeks and days), weight, height, drugs (including total parental nutrition), dosage and route of administration. Before the study all possible oral nutritional products including banked breast milk were investigated if they contained parabens, without any finding. The data was collected anonymously keeping no identifying patient information. All drugs ingested by the patients were checked for content and amount of preservatives in the product monographs (SPC), or if absent, with the company responsible for the drug.

Results: During the two-month retrospective study 58 patients were admitted to the neonatal unit, Karolinska University Hospital Huddinge. Records from 57 patients were found and included in the study. The daily intake of methyl and propyl paraben among the term and pre-term neonates does not exceed the ADI for adults. The highest daily intake of methyl paraben that a neonate was exposed to was approximately 7 mg/kg/day and consequently does not exceed the ADI of 10 mg/kg/day.

Conclusion: This study shows that the neonates in our population did not exceed the ADI set up for adults, but the pre-term neonates are exposed to more methyl paraben and therefore are exposed to larger theoretical risks. Our pharmacokinetic calculations from the dosage findings don't expect any clinical risks but still the risk of hormone like effects and the possible accumulative risks are uncertain, which calls for a recognition of a child and neonatal specific ADI.

Reference

1. SCF. Opinion of the scientific panel on food additives, flavourings, processing aids and materials in contact with food on a request from the commission to para hydroxybenzoates (E214-219). The EFSA Journal 2004;83:1-26.

O6
Improving the safety of liquid tacrolimus suspension: switching from 0.5 mg/ml to 1 mg/ml solution in paediatric renal transplant recipients

Yincent Tse[1], Karen Maddison[2], Chris Hiller[2], Ian Smeaton[2], Heather Lambert[1], Nadeem Moghal[1]

[1]*Department of Paediatric Nephrology, Royal Victoria Infirmary, Newcastle upon Tyne, UK*

[2]*Department of Pharmacy, Royal Victoria Infirmary, Newcastle upon Tyne, UK*

Tacrolimus (FK506, Fujisawa) is an immunosuppressant which is widely used in paediatric renal transplant recipients and as an adjunct in the treatment of steroid dependent nephrotic syndrome. It has a narrow therapeutic range with large inter-individual variations between dose and serum level. Oral capsules of tacrolimus are commercially available. For patients unable to swallow capsules an unlicensed extemporaneous liquid suspension is available at a concentration of 0.5 mg/ml. We present one patient who became significantly under dosed because of confusion between mg and ml by the caregiver, leading to a transplant rejection episode. Communication of dose changes may be less ambiguous using a 1mg/ml preparation. A second transplant patient had unacceptably high blood levels when a different specials manufacturer prepared an alternative extemporaneous liquid formulation. We formulated a 1mg/ml sugar free suspension and have shown it to be stable for 6 months at room temperature. A service evaluation exercise was carried out on seven paediatric renal patients (three transplants, four nephrotic). On conversion to the new 1mg/ml suspension, 12 hour trough blood tacrolimus levels taken on changeover, 1 and 2 weeks afterwards showed little variation compared to the previous formulation. The product had good patient acceptability. We discuss the need for strict quality control in preparing extemporaneous medicines for children and the need for a safe medicine concentration.

P1
An audit of anti-infective use in paediatrics

M Shah

Pharmacy Department, St Mary's Hospital NHS Trust, London, UK

Objectives: To review anti-infective prescribing in accordance with Trust guidelines.

To investigate potential reasons for non-adherence to these guidelines.

To suggest ways in which adherence to guidelines may be further improved.

Methods: All patients admitted to the general medicine paediatric ward over a one-month period (Monday–Friday, excluding Saturday and Sunday) were enrolled in the audit. Data collection forms included: patient details – age and weight, anti-infective choice, dose, frequency, route and indication.

For anti-infectives prescribed against Trust policy; medical notes and/or prescribers were referred to in order to establish the reason for prescribing choice.

Results: 64 patients were included and a total of 99 anti-infectives prescribed. Forty-four of 99 (44.4%) anti-infectives were in accordance with Trust policy and 55 (55.5%) were not. Of these 55 anti-infectives, 18 (18%) were prescribed against guidelines and 37 (38%) had no guidelines in place for that indication. This indicated that of all the anti-infectives prescribed where there are guidelines in place (n = 62), 70.9% (44 of 62) were in accordance to guidelines.

Common reasons for non-adherence included lack of clarity or ambiguity over existing guidelines (11%) and use of alternative sources (e.g. BNF for Children – BNFC) accounting for 9% of reasons. For instance, guidelines for osteomyelitis suggest ceftriaxone [clindamycin, gentamicin]. This resulted in two separate incidences of patients receiving ceftriaxone in conjunction with clindamycin as first line therapy, when anti-infectives in brackets represent suitable alternatives to first line monotherapy. No known reason for non-adherence to guidelines accounted for only 11% (n = 6) of cases, indicating that overall guidelines that are in place are well referred to.

Conclusion: This audit highlights the need for more comprehensive anti-infective prescribing guidelines. Guidelines were absent for relatively common infections, such as, tonsillitis, cholangitis and pseudomonal sepsis. The results also demonstrated the absence of guidelines for prescribing of anti-infectives in both medical and surgical prophylaxis.

The second most common reason for not following anti-infective prescribing guidelines was due to misinterpretation. This suggests that more rigorous and user friendly guidelines are required, which are easier to interpret and unambiguous.

A small percentage of prescribers used alternative sources for guidance, such as the BNFC, as this is readily available on the ward. Current guidelines also lack references and information on the various sources of evidence used to compile them, more formal documentation with full reference details may improve compliance.

A multi-site approach is required to ensure that guidelines are shared between other specialist centres to ensure accurate, up-to-date and evidence-based care is accessible to all. These guidelines should be made readily available via the intranet and perhaps on stickers that can be attached to the back cover of BNFCs. By improving adherence to Trust guidelines and promoting uniform prescribing, patient care would be optimised whilst reducing the risk of anti-infective resistance.

P2
An audit of the cost effectiveness of a palivizumab clinic

M Ahmed

Pharmacy Department, St Mary's Hospital NHS Trust, London, UK

Objective: To audit the cost effectiveness of a palivizumab clinic.

Methods: Babies born at 34 weeks or under who fit the inclusion criteria for receiving palivizumab were included in the clinic. The inclusion criteria were a set of guidelines set by the JCVI and St Mary's NHS hospital. Babies included were those who are immunocompromised, infants who have been born severely premature (<34 weeks), or those with underlying cardiac or respiratory problems and those who were receiving home oxygen. A total of 24 patients were included in the clinic and monthly intramuscular injections were administered to each patient at a dose of 15 mg/kg, over the course of five months (from October 2006–February 2007). Due to the large number of patients, two clinics were held each month to accommodate for the large number of babies. Vials were shared amongst patients and the total cost per patient was calculated in addition to the overall total cost spent on the clinic. This was then compared to last year's overall spend on palivizumab and on the cost per patient.

Results: The expected cost of administering the injection to the 24 patients in the absence of a clinic was calculated to be £110,370, whereas in the presence of a clinic was calculated to be £88,433 (a cost saving of almost £20,000). Community nursing time was also saved, in that less time was spent travelling to patients' homes/missed appointments. Dosing/administration errors may also have been kept to a minimum, as two nurses were present at each clinic day providing a second check.

Conclusion: A palivizumab clinic is definitely a cost effective way of administering this very expensive drug.

P3
Use of lisinopril in children under 6 years of age

S Davies, E Kirk, S Arenas-Lopez, S Tomlin, A Tzifa, O Miller

Evelina Children's Hospital, London, UK

Objective: To audit the prescribing of lisinopril in children against formulary guidelines.

To observe the clinical management of children prescribed ACE inhibitors.

Methods: Retrospective review of medical notes, Electronic Patient Record (EPR) and Heart Suite computer programmes of patients under 6 years of age. Data analysed using Microsoft Excel.

Results: Thirty five patients identified as receiving Lisinopril during the study period, 26 were converted from captopril to lisinopril and nine did not have any other ACE inhibitor (ACEi) prior to commencing lisinopril. In the group converted from captopril to lisinopril, 100% (26/26) of patients were administered the correct initial dose of lisinopril. In total, 100% (35/35) of patients were prescribed a maintenance dose of lisinopril which was within the recommended guidelines.

3% of patients had no blood pressure (BP) measurements documented in the notes. From the remaining patients, 17% patients did not have BP measurements recorded every 15 minutes for the first hour post-lisinopril. 80% patients were monitored every 15 minutes for the first hour post-lisinopril; no significant changes were seen in terms of systolic or diastolic BPs.

Before starting lisinopril, 14% (5/35) of patients had no baseline plasma levels of urea, creatinine and potassium recorded on the EPR system or in the medical notes; following initiation of lisinopril, 20% (7/35) of patients had no plasma levels of urea, creatinine or potassium recorded on EPR or in the medical notes. Both baseline and post-lisinopril blood urea, creatinine and potassium levels were recorded for the remaining 66% (23/35) of patients and the levels remained within acceptable limits. There was considerable variability in the timing of blood measurements post-lisinopril initiation; this ranged from hours to months.

As to medication records, there was no information on notes regarding whether the patients were receiving tablets, liquids of either captopril or lisinopril as well as any other concomitant medication (only if the child was an inpatient).

Conclusion: Maintenance doses of lisinopril following conversion from captopril, or prescribed as the first ACEi, were in line with the current recommendations in the GSTT Paediatric Formulary. However, the audit

highlighted that patient monitoring was not consistent. There was great variability in the timing of blood tests after initiating lisinopril; this ranged from hours to months. Hypotension and renal impairment generally occur within 5 days after starting or modifying ACEi therapy, therefore monitoring should be performed within 5 days of starting lisinopril.

The data used to produce our formulary guidelines is based mainly on extrapolation of one adult study. There is no information on lisinopril use under 6 years of age. A research study needs to be carried out in order to look at dosing, safety and efficacy issues of this drug in this age group taking into account other information such as concomitant medications and formulations used. A research project is warranted.

P4

Poppy seeds in stomach aspirates: what are they?

C Tuleu[1], S Arenas-Lopez[2]

[1]*Centre for Paediatric Pharmacy Research, The School of Pharmacy, University of London, London, UK*

[2]*Pharmacy Department, Evelina Children's Hospital, London, UK*

Objective: To identify the nature of particles like "poppy seeds" found in gastric aspirate of a PICU child.

Methods: Scanning electron microscopy and HPLC-mass spectroscopy.

Results: Patients unable to swallow omeprazole tablets or capsules require liquid dispersions prepared extemporaneously. This practice is widespread at the bedside. The BNF-C recommends solid omeprazole preparations are dispersed in a large volume of water or 10 ml sodium bicarbonate solution 8.4%.

A 3 month old male infant received omeprazole as part of his gastroesophageal reflux treatment, together with domperidone and a thickening agent since the early neonatal period. He was admitted to our paediatric intensive care unit (PICU) for non-invasive respiratory support. His regular omeprazole dose was administered via a nasogastric tube in the evening, by dispersing a tablet (10 mg Losec MUPS®) in 10 ml water and giving a proportional volume. In our PICU, omeprazole is dispersed in water in preference to sodium bicarbonate solution, as long term use of the latter may potentiate metabolic alkalosis.

18 hours following omeprazole administration, the stomach contents aspirated prior to the next feed, contained particulate matter similar in appearance to poppy seeds. Similar particles were later seen within the faeces.

Scanning electron microscopy showed the particles were approximately spherical, hollow and had a mean size of 500–800 μm. MUPS® contain enteric coated omeprazole-containing spherical particles.

The stability of omeprazole is pH dependent; it rapidly degrades to a purple compound below pH 4, but has acceptable stability under alkaline conditions. In MUPS®, the enteric coating dissolves at pH greater than 5.5, preventing drug release before the small intestine. When dispersed in water and administered to this patient, the coating remained more or less intact, but there was sufficient duration of contact with stomach contents (pH 3–4) for the permeability of the enteric coating to increase. Penetration of stomach content resulted in drug degradation, producing the dark purple colouration. HPLC-mass spectroscopy showed the presence of omeprazole and its degradation products.

The appearance of these particulates may lead to confusion in clinicians and unnecessary invasive investigations. At another institution their appearance was sited as potential evidence of non-accidental injury.

Conclusion: Administration of liquid omeprazole dispersions prepared from oral tablets/capsules may impair clinical efficacy by compromising bioavailability. Consequently, such dispersions of omeprazole may be the wrong formulation or even the wrong therapeutic agent in this setting.

P5

Scoping study to identify and analyse interventions used to reduce errors in the calculation of neonatal and paediatric drug doses

S Conroy[1], J Collier[1], P Erskine[1], C Planner[2], D Sweis[2], L Haines[3], ICK Wong[2]

[1]*University of Nottingham, UK*

[2]*School of Pharmacy, London, UK*

[3]*Royal College of Paediatrics and Child Health, London, UK*

Objective: To identify interventions which may help to reduce dose calculation errors in neonatal and paediatric patients and are transferrable across the NHS.

Methods: The study consisted of a systematic literature review, a questionnaire survey of paediatric healthcare professionals, observation and interview studies of selected interventions in practice followed by evaluation of observational reports by a multidisciplinary expert panel.

Results: The literature review found 30 relevant articles. The main interventions highlighted were electronic prescribing systems and unit dose dispensing systems.

The questionnaire survey of paediatricians and paediatric clinical pharmacists was done through several paediatric healthcare professional networks. 319/559 questionnaires were returned (57%); 149 replies described interventions used in their hospital. 424 separate interventions were described. These included technological interventions such as electronic prescribing programmes and 'smart' intravenous infusion pumps; healthcare professionals practice such as education, role of clinical pharmacists, use of a quiet room and double checking and other interventions such as monographs/guidelines and books/formularies.

Twent-one interventions were selected by the expert multidisciplinary panel for observation in clinical practice. These included electronic prescribing systems, 'smart' intravenous infusion pumps, commercial computerised prescribing packages (Chemocare, Carevue, Pedisuite), 'home grown' electronic packages, methods of double checking, methods of education and Centralised Intravenous Additive Services (CIVAS).

The reports following the observations and interview studies were ranked by the multidisciplinary expert panel in terms of cost, transferability and ability to reduce error. CIVAS, double checking procedures and 'smart' intravenous infusion pumps were rated as the top three interventions to reduce the risk of neonatal and paediatric dose calculation errors.

Conclusion: CIVAS, double checking procedures and 'smart' intravenous infusion pumps were deemed by an expert panel to be the most promising of the interventions currently in use to reduce the risk of neonatal and paediatric dose calculation errors.

P6

An evaluation of the effect of an electronic infusion calculator on prescribing errors within paediatric intensive care

LC Dunsmure, P North-Lewis, R Smith

Leeds Teaching Hospitals, Leeds, UK

Objective: The two paediatric intensive care units (PICUs) within Leeds General Infirmary historically prescribed infusions in different ways. One unit used mg/kg infusions; the other used standard solutions where possible. A baseline audit conducted in 2006 identified that prescribing errors occurred when doctors moved between units. In 2007, practice was standardised through the development and introduction of an electronic infusion calculator for infusions regularly used on PICU. Each patient has a patient specific calculator printed on admission. The calculator uses the mg/kg technique to advise doctors and nurses of the quantity of medication to put in a 50 ml syringe, the appropriate dose range and the appropriate diluents for each medication. The objective of the audit was to evaluate the effect of the calculator on errors associated with the prescribing of infusions.

Methods: The audit was based on the PICU and paediatric cardiology intensive care unit at Leeds General Infirmary. All paediatric and adolescent inpatients receiving infusions on these units over a six month period were included in the audit. The accuracy of prescribing of infusions was assessed using the trusts medicines code criteria and comparing the infusion prescribed to the patient specific infusion calculator. Deviations from standard practice were recorded to allow error patterns to be detected.

Results: During the six month study period, there were 458 patients in 2007 who required an infusion. This was similar to the number of patients requiring an infusion during the six month study period in 2006 (447). In 2007, however, there were only four prescribing errors reported whereas in the preceding year there had been 21 errors reported.

Conclusion: The aims and objectives of the audit were satisfied with very encouraging results. The infusion calculator has been shown to be effective in reducing prescribing errors associated with infusions prescribed on PICU.

P7

An audit of intravenous vancomycin dosing in paediatrics

H Youredjian, D Patel, P J Fletcher

Pharmacy Department, St Mary's Hospital NHS Trust, London, UK

Objectives: To review the literature relating to the monitoring of pre-dose (trough) and post-dose (peak) serum vancomycin levels in children.

To audit the dosage regimens of intravenous (IV) vancomycin used on paediatric wards.

To compare the BNF-C recommendation of 15 mg/kg three times a day (tds) with the Medicines for Children (2003) recommendation of 10 mg/kg four times a day (qds) with a 15 mg/kg loading dose, in terms of which is most likely to produce target pre-dose levels of 5–15 mg/l.

Methods: A literature review was conducted using PubMed and Ingenta to establish the necessity for measuring both peak and trough levels. A data collection form was designed to record dosage regimens prescribed and any vancomycin levels measured. Data were collected for 7 months. Standard: 80% of patients should achieve trough serum vancomycin levels between 5 and 15mg/l.

Results: A reasonable case exists for measuring only trough concentrations[1]. If trough concentrations do not exceed 15 mg/l, peak levels will not generally exceed desired peak concentrations[2]. A recent recommendation suggests a higher trough of 10–15 mg/l compared to the previously advocated 5–10 mg/l. 30 children were audited with a total of 55 prescriptions for vancomycin. A total of 217 vancomycin levels were taken. All patients were initiated on either 10 mg/kg qds (loaded with 15 mg/kg) or 15 mg/kg tds. Doses were then changed based on levels.

Of the patients initiated on 10 mg/kg qds, 49% of the levels were between 5 and 10 mg/l and 29% were between 10 and 15 mg/l. Of the patients initiated on 15 mg/kg tds, 51% of the levels were between 5 and 10 mg/l and 27% were between 10 and 15 mg/l. Overall, target trough levels of 5–15 mg/l were achieved in 78% of cases. Of the patients initiated on 10 mg/kg qds 13% of the levels were below 5 mg/l and 9% were above 15 mg/l. Of the patients initiated on 15 mg/kg tds 14% of the levels were below 5 mg/l and 9% were above 15 mg/l.

Conclusion: The two dosing schedules produced almost identical drug levels. Prescribers should use the latest reference source for paediatric dosing, i.e. the BNF-C. tds dosing is easier for nurses, will save time and may reduce drug costs. As the majority of prescribing decisions are made during the day, tds dosing at 6 am, 2 pm and 10 pm may also facilitate drug levels to be taken during the day rather than overnight as may happen with qds dosing. A local guideline should be produced stating the initial dose to be used, when to take a level, and to only monitor trough levels. Further work should be undertaken to compare the two dose regimens using a larger number of patients and measuring outcomes based on dosage regimens and monitoring.

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P8

A cost-effective approach to the prescribing of palivizumab in the community

L Marshall[1], W Kelsall[2], N Gooding[3]

[1]*Cambridge Community Children's Nurses, Cambridgeshire PCT, UK*

[2]*Neonatal Intensive Care Unit, Addenbrookes Hospital, Cambridge, UK*

[3]*Pharmacy department, Addenbrookes Hospital, Cambridge, UK*

Background: Despite national recommendations, there is still debate around the benefit of palivizumab in a climate where there are not enough resources to provide palivizumab therapy to all children who would meet the criteria in these recommendations. Literature suggests that the implementation of a centralised clinic may help with the costs associated with prescribing and administration of palivizumab.

Aim: To produce local recommendations for the prescribing of palivizumab and introduce a centralised nurse-led clinic for the administration of palivizumab in the community.

Methods: Local guidelines were produced and submitted to the local Drug and Therapeutics Committee for prescribing of palivizumab therapy. Two named consultants were identified as prescribers for palivizumab. A working party was selected to pilot a nurse led clinic for 2006–07 winter season. Patients who met the agreed local guideline were selected and invited by the Cambridge Children's Community Nursing Team to attend monthly clinics. At the end of the season families were then asked to complete a questionnaire to evaluate the service.

Results: 16 infants received palivizumab in Cambridge in 2006–07 (with 47 doses administered at the centralised clinic) compared with 10 infants (where 13 doses were administered by home community visits) in 2005–06. Average cost per dose of palivizumab administered reduced by 42.5% when compared with the 2005–06 season. The clinic also saved a total of £13,574 in nursing hours, drug savings and hospital attendance recharges. Of the eight questionnaires sent to families to evaluate the clinic, five were returned. All five families reported full satisfaction from the clinic.

Conclusion: The centralised clinic has been cost effective in medical, pharmacy and nursing terms. More importantly the clinic was also received favourably by the families. Future development includes the production of a Patient Group Direction to allow dosage at each clinic to be administered using the infant's weight at the clinic visit without the need for advance prescribing of palivizumab. In addition cost may also be saved by having just one nurse and one health care assistant per clinic. It is recommended that other units take on board the efficiency results and consider providing centralised clinics where palivizumab is administered.

P9

Comparing methods of calculating body surface area on a young persons unit

N Mayne, K Warnes

University College Hospital, London, UK

Objectives: Patients treated on the Teenage Cancer Trust Unit (TCTU) at University College Hospital (UCH) are treated by two different teams of clinicians. Those treated by the paediatric team have their body surface area (BSA) calculated using the United Kingdom Children's Cancer Services Group (UKCCSG) nomogram, relying only on the patients weight. Those treated by the adult clinicians have their BSA calculated using the Dubois & Dubois method; using height and weight. Ultimately it means two patients matched in terms of age and size may have their chemo-

therapy doses calculated on a different BSA. It has been suggested that the two methods can give rise to significantly different chemotherapy doses.

As estimates for BSA become less accurate in patients outside the "normal" weight range for their height, it is possible that variation between calculation methods in these patients may be greater. Existing evidence supports the use of Dubois and Dubois for calculating BSA in adults and the UKCCSG nomogram for calculations in children but what remains unclear is the point where one method should be used in place of the other. This study aims to address this issue.

Methods: Over a 9 month period data was collected on the height, weight, age, Body Mass Index (BMI) and chemotherapy of patients on TCTU and used to calculate BSA by four different methods; Dubois & Dubois[1], UKCCSG (Boyd's formula)[2], Mosteller[3] and Haycock[4]. Percentage deviations were calculated from each of the two methods used on the ward[1, 2]. These were subsequently compared with BMI to see if calculating BSA in patients outside the "normal" weight range for their height resulted in greater variation in estimated values. In this study "normal" was defined as patients with a BMI of 19–30.

Results: Data was collected prospectively on 60 patients between 13 and 19 years of age receiving treatment for 15 different haematological and oncological malignancies. Over the 9 month period, BMI ranged from 15 to 44.3 and weight from 41.2 to 125kg. Estimates for BSA using the UKCCSG nomogram, ranged from between 9.6% less to 20.6% more than those using the Dubois & Dubois formula. There was a clear linear relationship between BMI and the variation seen between the two methods. For patients within the normal BMI range, the variation was less than 10%.

Conclusion: Measuring BSA in Young People gives estimates within 10% for patients with a BMI within the normal range. In patients that are obese or underweight estimates can vary by up to 20% between the UKCCSG nomogram and Dubois and Dubois calculation. It seems reasonable to predict that calculations involving height and weight would provide better estimates in this group of patients and should be considered for use in this patient group.

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P10
Retrospective observational study of adverse effects of medication administered to inpatients on a child and adolescent psychiatric ward

J Baker, T Collinson, C Cummins, S Handy, C Norton, L Sivaprasad, F Zaw

Birmingham Children's Hospital NHS Foundation Trust, Birmingham, UK

Objectives: There is widespread use of psychotropic medications in child psychiatry, despite sparse and poor quality evidence, with much off-label and unlicensed drug use[1]. We aimed to ascertain adverse events associated with psychotropic medicines used in the controlled environment of a child and adolescent psychiatric ward.

Methods: A retrospective cohort study of patients admitted to a tertiary inpatient psychiatric ward was performed. Diagnoses (ICD-10 and DSM-IV) and outcomes (retention, clinical global impression, symptoms and discharge decision) were reviewed by a psychiatrist. A pharmacist reviewed drug usage, collecting information on dosage and time between increments, and on adverse events, weight changes, biochemical parameters, blood counts and specialist investigations.

Results: 94 patients admitted between 1997 and 2003 were included in the study. 14 were omitted because ward or medical notes were unavailable. There were 206 ICD10 axis 1 diagnoses. The patients' diagnoses were most commonly: hyperkinetic disorder (HD) (31), tics (16), pervasive developmental disorder (15), somatiform (12), depressive (11), oppositional defiant disorder (ODD) (11), anxiety disorders (five), obsessive–compulsive disorder (OCD) (10), psychotic (10), Asperger's (10), dissociative (10), separation anxiety (nine), diagnosis other than axis 1 diagnosis (nine), anorexia nervosa (seven). Six had HD alone, four had tic alone, four had somatiform diagnoses, four dissociative, three psychotic. Three had HD and ODD. Three children had four diagnoses, 17 had three, 37 had two. There were 68 different combinations of disorders on admission, reflecting the complex inpatient case mix. Fifty-six (60%) were male, and patients were aged between 4 and 16, (median 11.4). Atypical antipsychotics were used in 39 patients (risperidone 28, amisulpride seven, olanzapine two, quetiapine two); and antidepressants in 37 patients (SSRIs 28, (paroxetine 14, sertraline nine, fluoxetine four, fluvoxamine one) tricyclics six (imipramine two, amitriptyline two, clomipramine two), SNRIs (venlafaxine) in three patients). Stimulants (methylphenidate 20, dexamfetamine 10, modafinil two) were used in 32 patients, mood stabilisers in 26 patients (carbamazepine one, valproate 10, lamotrigine four, lithium one) and melatonin in 20 patients.

Adverse effects observed included clinically significant weight gain in 15 patients associated with risperidone (seven), amisulpride (four), semisodium valproate (two) olanzapine (one) ,others (three). Other adverse effects included gastrointestinal disorders (16), suicidal ideation/ self harm (15) of which 13 were on SSRIs/ SNRIs, movement disorders including five extra-pyramidal side-effects (EPSE) with risperidone and drowsiness (15) of which 11 were due to antipsychotics including seven with risperidone. Other events included rashes (six), cardiovascular side effects (five) and hallucinations/ nightmares (four).

Conclusion: While randomised controlled trials of drugs used in child psychiatry are needed, observational studies can provide further evidence on drug safety, particular when medicines are used outside their licensed indication.

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P11
An audit of adherence to Swansea NHS Trust multidisciplinary guidelines on 'acute pain management in children and young people'

H Atkin, E Nurse

Pharmacy Department, Swansea Hospitals, Wales, UK

Acute pain is a common adverse stimulus experienced by children. Unrecognised and uncontrolled pain can have an adverse effect upon cardiovascular, respiratory, immunological and metabolic processes.

Methods: Children receiving analgesia for acute pain were identified during the audit. The number and nature of analgesic related prescribing errors and non-conformance to trust pain guidelines were identified in order to assess current practice. This was done retrospectively by comparing the analgesics prescribed on drug charts with Trust guidelines. The acceptance standard of the audit was 100% adherence to guidelines.

Results:

Morriston Hospital: 115 drug charts were assessed. Only 18.3% ($n = 21$) of the charts assessed adhered to guidelines. A total of 97 analgesic related prescribing errors were detected. The majority of charts ($n = 67$) were associated

with one or more error. The maximum number of errors detected on a chart was 4 (n = 3). Prescribing analgesics at an incorrect dose frequency was the most common error (n = 21) encountered. A total of 100 non-conformance issues were detected. Over half of the charts assessed (n = 74) were associated with one or more non-conformance issue. The maximum number of non-conformance issues detected on a chart was three (n = 2). Not prescribing naloxone with morphine was the most common non-conformance issue (n = 53).

Singleton Hospital: 119 drug charts were assessed. Only 10.9% (n =13) of the charts assessed adhered to guidelines. A total of 73 analgesic related prescribing errors were detected. The majority of charts (n = 59) were associated with one or more prescribing error. The maximum number of errors detected was three (n = 1). Directing analgesics to be given when necessary when a regular dose was needed was the most common error (n = 41) encountered. A total of 123 non-conformance issues were detected. Over half of the charts assessed (n = 94) were associated with one or more non-conformance issue. The maximum number of non-conformance issues detected on a chart was two (n = 29). Not recording any of the analgesics given in theatre on the drug chart was the most common non-conformance issue (n = 73) encountered.

Conclusions: 100% adherence to Swansea NHS Trust pain management guidelines in children was not achieved. The majority of errors and non-conformance issues identified were common to all prescribers, and were not associated with children of a particular age group. Results suggested that prescribers were not familiar with the acute pain management guidelines. These guidelines must be promoted and be made easily accessible to all prescribers. The option of producing pre-printed labels for commonly prescribed analgesics will be under consideration.

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P12
An audit on the use of surfactant in premature babies with or at risk of respiratory distress syndrome at Queen Mary's Hospital, Sidcup

R Patel

Queen Mary's Hospital, Sidcup, Kent, UK

Objective: The aim of the study was to evaluate the use of exogenous natural surfactant for Respiratory Distress Syndrome (RDS) on the Neonatal Unit at Queen Mary's Hospital (QMH) and adherence to the QMH guidelines.

Methods: A retrospective audit was undertaken over a 12 month period between January to December 2006. All babies less than 30 weeks gestation (who are considered to be at high risk of RDS and who should therefore be given prophylactic surfactant at birth) and all those babies of more than 30 weeks gestation that received surfactant as a rescue treatment were identified.

Results: It was found that surfactant was administered to only 15 out of 43 babies of <30 weeks gestation who should have received a prophylactic dose of surfactant according to the Trust guidelines. 67% (six out of nine) of the babies administered a prophylactic dose received the dose within 10 minutes of birth with 88% (eight out of nine) receiving the dose recommended in the guidelines. In the group receiving a rescue treatment of surfactant, 73% (eight out of 11) received the dose recommended in the guidelines and a second administration was required in three patients. Examining both the prophylactic and treatment doses received by the babies in the study, 65% (13 out of 20) babies received a licensed dose of between 100 and 200 mg/kg of Curosurf (Poractant alfa), with the remainder receiving a dose of less than 100 mg/kg.

Conclusion: This audit has highlighted the need to review QMH guidelines.

Reference

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