LETTERS TO THE EDITOR

Intravenous midazolam in small bowel biopsy

EDITOR,—Small bowel biopsy has an important role in paediatric gastroenterology. The diagnosis of coeliac disease, the second most common chronic disease in Swedish children, is fully based for instance on the findings of serial small bowel biopsies. In Sweden most paediatric centres perform biopsies using peroral capsule instruments and without general anaesthesia. This biopsy procedure is uncomfortable to children. Optimal sedation is thus essential. Moreover, in a well sedated child the radiation dose can be minimised.¹ We have previously found intravenous midazolam to be effective and superior to other sedatives given orally.² The recommended intravenous dose of midazolam in children is 0.10–0.20 mg/kg body weight.³ However, with increasing experience of the preparation it became obvious to us that the dosage must be adjusted according to the age of the child.

During the period between April 1991 and April 1994, 269 peroral small bowel biopsies were performed. Twenty nine patients were excluded from the study because they had received no sedation, or an alternative to intravenous midazolam. The remaining 240 children (table 1) were sedated with intravenous midazolam immediately before the biopsy procedure. The midazolam was given repeatedly with five minute intervals until the sedation was at least grade 3 on a five grade scale according to Karl *et al.*,⁴ grade 1 being agitated, 2 anxious, 3 calm, 4 drowsy, and 5 asleep. The total amount of midazolam given before the biopsy was recorded. In addition metoclopramide 0.30 mg/kg body weight (maximum dose 10 mg) was given intravenously immediately before the midazolam was administered. If the biopsy procedure was more time consuming an additional reduced dose of midazolam was given if sedation was considered inadequate, that is, less than grade 3 on the five grade scale.

The biopsy was performed on an outpatient basis but the children remained under observation in the hospital after the biopsy until they were fully awake and had eaten a light meal. The paediatric Storz capsule (Karl Storz KG, Germany) was used in 208 cases and the paediatric Watson capsule

Table 2 Recommended dosage of midazolam for intravenous administration to paediatric patients

Age (years)	Dose of intravenous midazolam (mg/kg body weight)
0–0.9	0.25
1.0–3.9	0.30
4.0–5.9	0.25
6.0–9.9	0.20
10.0–17.9	0.10

(Ferraris Development and Engineering) with angiography catheter in 32 cases. The procedure was performed under intermittent fluoroscopy. The total fluoroscopy time and the procedure time, measured from the moment the child had swallowed the capsule and the fluoroscopy was started to the moment the capsule was fired, were registered.

The benzodiazepine antagonist flumazenil 0.20 mg was given intravenously to 15 children (median age 11.0 years; range 10 months–17.3 years) after the biopsy for practical purposes (n=10) or because of unnecessarily deep residual sedation (n=5), including two children with Down's syndrome, one child with juvenile diabetes mellitus, and one infant with a newly diagnosed coeliac disease in a rather bad general condition. Resuscitative equipment was immediately available at the bedside.

The midazolam doses given before biopsy to children of various ages are presented in table 1. Children between 1.0 and 3.9 years of age required significantly higher doses (mean (SD) 0.30 (0.10) mg/kg body weight) than did adolescents over 10 years (0.10 (0.05) mg/kg body weight) (p<0.001; Student's *t* test). The median biopsy time was 5 (range 1–45) minutes and the median fluoroscopy time was 5 (range 1–48) seconds. Bronchial hypersecretion was observed in 15 children including three children with Down's syndrome, but there was no serious adverse effect.

These results indicate that midazolam given intravenously in the age related dosage recommended in table 2 gives short procedure and fluoroscopy times and is an effective and safe means of sedation for paediatric patients undergoing peroral small bowel biopsy.

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Table 1 Data on 240 patients and doses of midazolam given

No of patients	Age (years)	Mean (SD) intravenous midazolam (mg/kg body weight)
25	0–0.9	0.25 (0.10)
77	1.0–1.9	0.30 (0.10)
55	2.0–2.9	0.30 (0.10)
17	3.0–3.9	0.30 (0.15)
20	4.0–5.9	0.25 (0.10)
17	6.0–9.9	0.20 (0.10)
29	10.0–17.9	0.10 (0.05)

- Persliden J, Pettersson HBL, Stenhammar L, Fälth-Magnusson K. Small intestine biopsy of children with coeliac disease: influence of X-ray equipment on radiation dose. *European Radiology* 1994; 4: 458–61.
- Stenhammar L, Wängård O, Lewander P, Nordvall M. Oral versus intravenous premedication for small bowel biopsy in children: effect on procedure and fluoroscopy times. *Acta Paediatr* 1993; 82: 49–51.
- Cole WHJ. Midazolam in paediatric anaesthesia. *Anaesth Intensive Care* 1982; 10: 36–9.
- Karl HW, Keifer AT, Rosenberger JL, Larach MG, Ruffle JM. Comparison of the safety and efficacy of intranasal midazolam or sufentanil for preinduction of anaesthesia in pediatric patients. *Anesthesiology* 1992; 76: 209–15.

Jet nebulising systems for recombinant human DNase I

EDITOR,—Recombinant human DNase I (rhDNase, dornase alfa, Pulmozyme) has been shown to be beneficial in improving lung function and reducing infective episodes in cystic fibrosis patients with mild to moderate lung disease.¹ In all the clinical trials, weak compressor nebulising systems (Hudson T Updraft II nebuliser/Pulmo-aide compressor, Marquest Acorn II nebuliser/Pulmo-aide compressor, and Pari LC nebuliser/Proneb compressor) were used as there is worry that more powerful nebulising systems may excessively inactivate the enzyme product. In Britain, the manufacturer also recommends the use of Medic-aid Sidestream nebuliser/CR50 compressor (which is provided with a drug). Interestingly, none of the trials so far have used this combination.

In our cystic fibrosis clinic, more powerful compressors (either Medic-aid CR60 or Medix Turboneb) coupled with either Life-care MicroNeb III or Medic-aid System 22 Acorn nebulisers are used routinely for the delivery of inhaled antibiotics, amiloride etc. We have carried out a pilot study to assess their performance in delivering active DNase aerosol by comparing them with two of the recommended systems (Hudson T Updraft II nebuliser/Pulmo-aide compressor and Medic-aid Sidestream nebuliser/CR50 compressor). A sample of 2.5 mg (2.5 ml) rhDNase was nebulised with each system. Particle size was measured by a Malvern 2600 laser particle sizer. The released aerosols were dissolved in 0.15 M sodium chloride by drawing it through an 'under-water' seal. The DNase activity was measured immediately by spectrophotometric method as described by Sigma Chemical Company based on the Kunitz unit.² One Kunitz unit will produce a ΔA_{260nm} of 0.001 per minute per ml at pH 5.0 at 25°C using DNA as the substrate.

The results are shown in the table. Our data do not suggest excessive inactivation by our nebulising systems (Turboneb and CR60) when compared with the recommended systems (CR50 and Pulmo-aide). In terms of particle size, CR60 or Turboneb coupled with MicroNeb III is comparable to the recommended systems. For the Sidestream nebuliser, a nebulisation time of around three minutes may be too brief for children with smaller minute volumes.³ A duration of five to 10 minutes is likely to be less wasteful. The nebulisation time of the Sidestream nebuliser can be increased by using a mouthpiece which blocks off the Venturi vent at the outlet top.

The preliminary trial results in patients with severe lung disease (forced vital capacity <40% predicted) are not impressive.⁴ This may be partly because the severely distorted airways prevent the relatively large aerosol particles from reaching the intended target sites. The use of more powerful systems,⁵ for example CR60 coupled with Sidestream, to generate small aerosol particles, is likely to improve drug delivery to the patients. It is now our policy that patients should continue to use their existing compressors for the nebulisation of rhDNase and clinical improvement in our patients has been detected regardless of the systems used. This also avoids the need to use two compressor systems at home.

Comparison of six jet nebulising systems for the nebulisation of rhDNase (2.5 mg in 2.5 ml)

Compressor + Nebuliser	Recommended systems		RMCH systems		
	Pulmo-aid + Updraft	CR50 + Sidestream	CR60 + Sidestream	CR60 + MicroNeb III	Turboneb + MicroNeb III
Median mean diameter (µm)	5.19	5.23	3.83	4.89	4.87
Nebulisation time (min)	6.57	2.9	3.85	6.83	5.88
Residual volume (ml)	0.5	0.6	0.4	0.6	0.7
% Of activity in the released aerosols*	73	71	65	64	65

RMCH=Royal Manchester Children's Hospital.

*The activity of 2.5 mg (in 2.5 ml) rhDNase is taken as 100%.

Further efficacy trials are urgently required to evaluate the dose-response relationship of rhDNase when it is delivered by different nebulising systems.

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- 1 Ranasinha C, Assoufi B, Shak S, *et al.* Efficacy and safety of short-term administration of aerosolised recombinant human DNase I in adults with stable stage cystic fibrosis. *Lancet* 1993; 342: 199-202.
- 2 Kunitz M. Crystalline desoxyribonuclease 1. Isolation and general properties: spectrophotometric method for the measurement of desoxyribonuclease activity. *J Gen Physiol* 1950; 33: 349-62.
- 3 Everard ML, Clark AR, Milner AD. Drug delivery from jet nebulisers. *Arch Dis Child* 1992; 67: 586-91.
- 4 Shah PL, Scott SF, Hodson ME. Report on a multicentre study using aerosolised recombinant human DNase I in the treatment of cystic fibrosis patients with severe pulmonary disease. *Pediatr Pulmonol Suppl* 1993; 9: 157-8.
- 5 Newman SP, Woodman G, Clarke SW. Deposition of carbenicillin aerosols in cystic fibrosis: effects of nebuliser system and breathing pattern. *Thorax* 1988; 43: 318-22.

Adverse events occurring during interhospital transfer of the critically ill

EDITOR,—The study by Barry and Ralston is extremely important in highlighting the dangers associated with transport of critically ill children by non-specialised personnel.¹ The fact that 75% of their patients suffered from serious clinical complications during transfer by non-specialised teams is both alarming and unacceptable. It is indeed very unfortunate that in spite of recent recommendations some critically ill children in the UK are still being transferred by non-specialised teams. A recent study from the US has shown that the use of specialised paediatric retrieval teams reduces the morbidity of interhospital transport.²

We have recently completed a study (in preparation for publication) looking at the morbidity associated with the transfer of 51 critically ill children by our specialised paediatric intensive care retrieval team. Morbidity during transport was assessed in terms of physiological deterioration and equipment related adverse events using the criteria described by Kanter and Tompkins.³ Only two (3.9%) patients had possibly preventable deterioration (episodes of apnoea and oxygen desaturation in one patient and hypoglycaemia in the other) during transport and there were no instances of equipment related adverse events. Severity of illness in our patients, as measured by the median (range) PRISM score on admission at the

referring hospital decreased from 14 (1-45) to 8 (0-23) on arrival at our paediatric intensive care unit.

Our study suggests that a specialised paediatric retrieval team can not only institute intensive care on arrival at the referring hospital, but also transport the patient back to a tertiary centre with an improvement in the severity of illness and minimal morbidity, demonstrating that similar unequivocal results can be achieved here in the UK. These results should strengthen the case for specialised paediatric retrieval even further.

A regional specialised paediatric intensive care retrieval service catering to meet all the demands of the region would seem the ideal solution for the future. For the present, however, tertiary centre intensive care units that accept critically ill children should try and extend the benefits of paediatric intensive care to the child awaiting transfer by sending out specialised retrieval teams to the referring hospital, thereby initiating intensive care earlier and decreasing the morbidity associated with non-specialised retrieval.

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- 1 Barry PW, Ralston C. Adverse events occurring during inter hospital transfer of the critically ill. *Arch Dis Child* 1994; 71: 8-11.
- 2 Edge WE, Kanter RK, Weigle CGM, *et al.* Reduction of morbidity in interhospital transport by specialised pediatric staff. *Crit Care Med* 1994; 22: 1186-91.
- 3 Kanter RK, Tompkins JM. Adverse events during interhospital transport: physiological deterioration associated with pretransport severity of illness. *Pediatrics* 1989; 84: 43-8.

Patterns of scald injuries

EDITOR,—Yeoh *et al* found only four children with non-accidental scalds out of a total of 68 bath scald injuries treated in a burns unit in 2.5 years.¹ The authors rightly draw attention to the unacceptably hot and in some cases dangerous temperatures in many household hot water systems. However in this country fewer cases of abuse are recognised than in the USA where there have been more studies. Tennant and Davison did not find a single case of non-accidental bath scald injury in 91 cases, although 60% were aged 2 years or less.²

Why should experience in Cardiff and Edinburgh be so different to cities in the USA?

In the USA estimates vary from 10-25% of burns being deliberately inflicted by adults.³ In one study of 71 inflicted burns the most

frequent cause of injury were scalds (83% tap water) which involved buttocks, perineum, feet (or foot), hands (or hand) in various combinations.³ In contrast, genuinely accidental scald injuries are more often due to causes other than tap water (15.7%). Studies have emphasised the young age in abuse with many below 3 years.

Many children with abusive burns and scalds will not in our experience have other injuries such as bruises or fractures (only 19.7%).³ The diagnosis will depend on a high index of suspicion (abuse until proved otherwise) and an awareness that adults do understand the burning hazard associated with hot tap water. Such scalds should not be excused by a purported lack of knowledge. This observation is supported by the virtual absence of accidental tap water burns in non-impaired adults.⁴

Paediatricians must be aware of the features associated with deliberate immersion. Careful consideration of the history including analysis of scald pattern in relation to child's development (ability to get into the bath, etc) and a knowledge of the detailed environment and parental behaviour at the time the injury was sustained are needed. Paediatricians should develop protocols and systems for the investigation of tap water scald injuries as few will be compatible with acceptable child care practice but involve either deliberate injury or neglect. Parent education and manipulation of water temperature are unlikely to be sufficient protection for these vulnerable children. At present too few cases are being recognised and reported.

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- 1 Yeoh C, Nixon JW, Dickson W, Kemp A, Sibert JR. Patterns of scald injuries. *Arch Dis Child* 1994; 71: 156-8.
- 2 Tennant WG, Davison PM. Bath scalds in children in the south-east of Scotland. *J R Coll Surg Edinb* 1991; 36: 319-22.
- 3 Purdue GF, Hunt JL, Prescott PR. Child abuse by burning - an index of suspicion. *J Trauma* 1988; 28: 221-4.
- 4 Purdue GF, Hunt JL. Burn injuries. In: Ludwig S, Kornberg AE, eds. *Child abuse, a medical reference*. 2nd Ed. New York: Churchill Livingstone, 1992.

Attitudes and beliefs of Muslim mothers towards pregnancy and infancy

EDITOR,—The article by Gatrad on attitudes and beliefs of Muslim mothers towards pregnancy and infancy is timely and appropriate.¹ However as a practising Muslim paediatrician I found his article intriguing because he seems to mix and confuse Muslim and cultural beliefs with each other.

Although in some cultures pregnant women continue to fast during the fasting month of Ramadan, religiously it is discouraged. The practice of giving honey to the baby or tying a string around the baby's neck or wrist are both entirely cultural and have no religious basis whatsoever. Similarly the use of a mixture of herbs and nuts cooked in wheat and purified butter during the post-natal period is very much part of Indian culture and is not seen in many other Muslim parts of the world, for example Arabia. Gatrad goes on to quote other cultural issues and confuses them with Islam, for example