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 may 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 (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 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. Respiratory 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

<table>
<thead>
<tr>
<th>No of patients</th>
<th>Age (years)</th>
<th>Mean (SD) intravenous midazolam (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0-0-9</td>
<td>0-25 (0-10)</td>
</tr>
<tr>
<td>77</td>
<td>1-0-1-9</td>
<td>0-30 (0-10)</td>
</tr>
<tr>
<td>55</td>
<td>2-0-2-9</td>
<td>0-30 (0-10)</td>
</tr>
<tr>
<td>17</td>
<td>3-0-3-9</td>
<td>0-30 (0-10)</td>
</tr>
<tr>
<td>17</td>
<td>4-0-5-9</td>
<td>0-25 (0-10)</td>
</tr>
<tr>
<td>17</td>
<td>5-0-6-9</td>
<td>0-20 (0-10)</td>
</tr>
<tr>
<td>29</td>
<td>6-0-9-9</td>
<td>0-20 (0-10)</td>
</tr>
<tr>
<td>29</td>
<td>10-0-17-9</td>
<td>0-10 (0-05)</td>
</tr>
</tbody>
</table>

5 Ferrari Development and Engineering.

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

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Dose of intravenous midazolam (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0-9</td>
<td>0-25</td>
</tr>
<tr>
<td>1-0-3-9</td>
<td>0-30</td>
</tr>
<tr>
<td>4-0-5-9</td>
<td>0-25</td>
</tr>
<tr>
<td>6-0-9-9</td>
<td>0-20</td>
</tr>
<tr>
<td>10-0-17-9</td>
<td>0-10</td>
</tr>
</tbody>
</table>
Comparison of six jet nebulising systems for the nebulisation of rhDNase (2.5 mg in 2.5 ml)

<table>
<thead>
<tr>
<th>Compressor + Nebuliser</th>
<th>Recommended systems</th>
<th>RMCH systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CR50</td>
<td>CR60</td>
</tr>
<tr>
<td>Palmo-aid Updraft</td>
<td>Sidestream CR50</td>
<td>Sidestream CR60+</td>
</tr>
</tbody>
</table>

- Median mean diameter (μm) range (range):
  - CR50: 5.19-5.23
  - CR60: 3.83-4.89
  - CR60+: 5.88
  - Turboneb: 6.83-6.83

- Residual volume (ml):
  - CR50: 5.19-5.23
  - CR60: 3.83-4.89
  - CR60+: 5.88
  - Turboneb: 6.83-6.83

- % Activity in the released aerosols:
  - CR50: 73-71
  - CR60: 65
  - CR60+: 65
  - Turboneb: 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.


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. 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.

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. 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 complications. The 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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Patterns of scald injuries

**EDITOR—**Yeoh C 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. 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. 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. 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. 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%). The diagnosis will depend on a high index of suspicion (abuse until proved otherwise) and an awareness that adults 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.

Paediatricians must be aware of the features associated with deliberate immersion. Careful consideration of the history and an analysis of the pattern in relation to the child’s development (ability to reach 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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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. However as a practising Muslim paediatrician I found this 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 Mawlid, religious belief is very much a function of age. The practice of giving honey to the baby or yewing 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 purifed butter during the postnatal period is very much part of Indian culture and is not seen in many other Muslim worlds. In cultures, such as amongst Muslim in the world, where women in the childbearing age age in Gatrad goes on to quote other cultural issues and confuses them with Islam, for example
Jet nebulising systems for recombinant human DNase I.

J C Hung, G Hambleton and M Super

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