PREOPERATIVE STARVATION AND PLASMA GLUCOSE CONCENTRATIONS IN CHILDREN UNDERGOING OUTPATIENT ANAESTHESIA

I. F. M. Graham

SUMMARY

Thirty-one children aged less than 5 years were studied while attending hospital for anaesthesia as outpatients. Plasma glucose concentrations were measured after the induction of anaesthesia. The mean plasma glucose concentration was $4.70 \text{ mmol litre}^{-1}$. No patient had a plasma glucose concentration less than $2.8 \text{ mmol litre}^{-1}$, despite at least 8 h of starvation. This is unexplained. It is suggested that the conclusions drawn from studies made in young inpatients may not be applicable to young outpatients.

As outpatient surgery becomes more popular, problems arise in the organization of anaesthesia. In paediatric practice it has been suggested that, in some patients, the period of starvation before operation may be excessive and may result in hypoglycaemia (Editorial, 1974). Preoperative feeding is sometimes employed in inpatient units, but this may not be practicable in outpatient units where a large number of patients may arrive simultaneously a short time before surgery.

At Alder Hey Children's Hospital, following studies made by Thomas (1974) which showed a surprisingly high frequency of hypoglycaemia in children of less than 4 yr, the feeding regime shown in Table I is employed routinely for inpatients. However, it is considered unlikely that these instructions would be followed sufficiently closely by the parents of children admitted to the outpatient ward. Therefore, they are instructed that "your child should have nothing to eat or drink after midnight". This represents an attempt to minimize the frequency of regurgitation of stomach contents during the induction of anaesthesia. In order to investigate the effect of this instruction, a survey was made of the plasma glucose concentrations in outpatients.

METHODS

Over a 2-month period, patients less than 5 yr undergoing general anaesthesia on a morning operating list were studied. This age group was chosen following the observation (Thomas, 1974) that intraoperative hypoglycaemia was found only in children less than 47 months old. After explanation of the purpose and nature of the study to the parent accompanying the patient, verbal consent was obtained. Information about the time and nature of the last normal meal and the last feed or drink was collected. Patients less than 1 yr were premedicated with atropine alone, older patients received atropine $20 \text{ ng kg}^{-1}$ and morphine $250 \text{ mg kg}^{-1}$, $1 \text{ h}$ before operation, except for one patient who received pethidine $1 \text{ mg kg}^{-1}$ plus atropine, and four patients who received no premedication.

Anaesthesia was induced with thiopentone $4 \text{ mg kg}^{-1}$, which was followed by a neuromuscular blocking drug (tubocurarine $750 \text{ mg kg}^{-1}$, pancuronium

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125 μg kg⁻¹ or suxamethonium 1 mg kg⁻¹). The trachea was intubated, and ventilation of the lungs with 66% nitrous oxide in oxygen was undertaken. Blood samples were withdrawn after the induction of anaesthesia but before surgery. Samples, either venous (28 patients) or capillary (three patients), were collected into fluoride bottles and sent to the laboratory for immediate analysis by the glucose oxidase method (Morley, Dawson and Marks, 1968).

The period of starvation before operation had ranged from less than 6 h to 17 h. There was no correlation between the duration of the period of starvation and the plasma glucose concentration (Spearman rank correlation coefficient = 0.07, P > 0.5) and this confirms an earlier study (Watson, 1972) which, however, included children up to 15 yr.

RESULTS

Thirty-one patients were studied. The surgery performed consisted of herniotomy (11 patients), circumcision (eight patients), anal dilation (five patients), removal of skin nodule (two patients), removal of foreign body from head, division of tongue tie, avulsion of toenail, urethral dilation, sigmoidoscopy and polypectomy (one each). The age distribution of the patients is shown in figure 1. The mean plasma glucose concentration obtained after the induction of anaesthesia was 4.70 mmol litre⁻¹ (SEM 0.21 mmol litre⁻¹).

Hypoglycaemia has been defined variously as a blood glucose concentration of less than 2.2 (Cornblath and Schwartz, 1976), 2.8 (Ehrlich, 1971) and 3.3 mmol litre⁻¹ (Bowie, Mulligan and Schwartz, 1963) (40, 50 and 60 mg dl⁻¹ respectively). Other studies of blood glucose concentrations obtained after the induction of anaesthesia (table II) have shown a frequency of hypoglycaemia which varied from 10% to 29% depending upon which definition was taken.

Caution must be exercised when comparing results from studies undertaken at different times and in different hospitals. The study reported by Thomas (1974) was undertaken in the same hospital as the present study and the plasma glucose concentration was measured by the same laboratory. The method of measuring the plasma glucose concentration had not changed, although results are expressed now in SI units (table III).

The patients studied by Thomas (1974) were inpatients who were anaesthetized using an anaesthetic technique similar to that employed in the present study, although pancuronium was the only neuromuscular blocking agent used. In addition, the patients had been premedicated with oral trimiprazine (Vallergan Forte) 3 h before operation, and blood was drawn from the long saphenous vein. The “starvation group” had received a light breakfast at 6 a.m., and were anaesthetized in the early afternoon.

DISCUSSION

Table II. Frequency of hypoglycaemia after induction

<table>
<thead>
<tr>
<th>Study</th>
<th>Upper age limit</th>
<th>No. of patients</th>
<th>&lt;2.2 (40 mg dl⁻¹)</th>
<th>&lt;2.8 (50 mg dl⁻¹)</th>
<th>&lt;3.3 (60 mg dl⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study</td>
<td>5 yr</td>
<td>31</td>
<td>0</td>
<td>0</td>
<td>4 (13%)</td>
</tr>
<tr>
<td>This study</td>
<td>4 yr</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Thomas (1974)</td>
<td>47 months</td>
<td>18</td>
<td>5 (28%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watson (1972)</td>
<td>15 yr</td>
<td>80</td>
<td>8 (10%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bevan &amp; Burn (1973)</td>
<td>10 yr</td>
<td>82</td>
<td></td>
<td></td>
<td>24 (29%)</td>
</tr>
</tbody>
</table>
was decreased significantly after 24 h starvation. (1974) reported blood glucose concentrations which were decreased significantly after 24 h starvation in children. Prolonged starvation studies in children have been reported. Senior (1973) has pointed out that the tendency for young children to become hypoglycaemic during fasting may have been known in Biblical times, and suggested that research was needed into the biochemical differences between the adult and the young child's response to starvation.

The starvation period in these young patients is often very long, but the difficulty of formulating simple yet safe feeding instructions is formidable. (The problems of communicating with patients have been emphasized by Ley (1977).) The failure to demonstrate significant hypoglycaemia in this group of young outpatients has not been explained and requires further investigation.

Anæsthetists should be aware that young outpatients admitted and anæsthetized soon after admission represent a special category, and that studies made on inpatients may not be applicable.

| TABLE III. Comparison of blood glucose concentrations in patients immediately following the induction of anaesthesia. Maximum age in present study was 5 yr. (The same level of significance is found when patients less than 4 yr are compared with Thomas’s studies) |
|---|---|---|
| No. of patients | 31 | 18 |
| Mean blood glucose (mmol litre\(^{-1}\)) | 4.70 | 2.58 |
| SD (mmol litre\(^{-1}\)) | 1.15 | 0.92 |
| t | 7.08 |
| P | <0.001 |

The present study concentrated on those patients considered by Thomas to be most at risk of developing hypoglycaemia. The apparent failure to demonstrate hypoglycaemia requires explanation. The possible relevance of different venous sampling sites is unknown. One would expect the glucose concentration in blood draining an exercising or recently exercised large muscle mass (for example, following a suxamethonium-induced fasciculation) to be less than in blood draining a more peripheral region. The influence of the different neuromuscular blocking agents has not been examined in this study.

Three of the plasma glucose concentrations were made on inpatients. If these three patients are excluded from consideration, the mean plasma glucose concentration is 4.59 mmol litre\(^{-1}\) while the standard error of the mean and the significance level of the difference from Thomas's study were unchanged. The use of an oral premedication containing sucrose 3 h before operation in Thomas's study may be relevant. However, as the maximum dose administered was equivalent to sucrose 3.25 g, it would seem unlikely to be the cause of a disturbance of plasma glucose concentration, particularly a rebound hypoglycaemia.

The present investigation, involving only 31 patients, does not indicate which of the factors are responsible for the apparent failure to demonstrate significant hypoglycaemia following the induction of anaesthesia. It may be that an extension of the long overnight fast is better tolerated than an extension of the fast between breakfast and luncheon. Prolonged starvation studies in children have been reported. Chaussain (1973) found that the capillary blood glucose concentration was significantly decreased after fasting for 8 h, while Chaussain and colleagues (1974) reported blood glucose concentrations which were decreased significantly after 24 h starvation.

Unlike the present study, these workers commenced the fasting period at noon. Bevan and Burn (1973), using arterialized capillary samples, studied a mixed group of inpatients, some of whom received an early breakfast, but all of whom had starved for at least 8 h. Of the 39 patients less than 5 yr, one appears to have had a blood glucose concentration of less than 2.8 mmol litre\(^{-1}\) (50 mg%). Whether the time of starting the fast affects the nature of the response to starvation in children remains unknown. Senior (1973) has pointed out that the tendency for young children to become hypoglycaemic during fasting may have been known in Biblical times, and suggested that research was needed into the biochemical differences between the adult and the young child's response to starvation.

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REFERENCES


JEUN PREOPERATOIRE ET CONCENTRATIONS DE GLUCOSE DANS LE PLASMA CHEZ DES ENFANTS SUBISSANT UNE ANESTHESIE EN TANT QUE MALADES DE CONSULTATION EXTERNE

RESUME
Trente-et-un enfants âgés de moins de 5 ans ont été observés pendant qu'ils étaient à l'hôpital pour subir une anesthésie en tant que malades de consultation externe. Les concentrations de glucose dans le plasma ont été mesurées après l'induction de l'anesthésie. La concentration moyenne de glucose dans le plasma a été de 4,70 mmol litre$^{-1}$. Aucun des patients n'a eu une concentration de glucose dans le plasma inférieure à 2,80 mmol litre$^{-1}$, en dépit du fait qu'ils étaient tous à jeun depuis au moins 8 h. Ceci ne s'explique pas. On suggère que les conclusions tirées des études faites sur les jeunes malades hospitalisés ne sont pas applicables aux jeunes malades de consultation externe.

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PRÄOPERATIVES FASTEN UND PLASMA-GLUKOSEKONZENTRATIONEN BEI KINDERN ALS AMBULANTE PATIENTEN NARKOTISIERT

ZUSAMMENFASSUNG

AYUNO PREOPERATORIO Y CONCENTRACIONES DE GLUCOSA EN LA PLASMA DE NIÑOS SOMETIDOS A ANESTESIA DE CONSULTORIO

SUMARIO
Se estudiaron 31 niños de edad inferior a los 5 años mientras asistían al hospital para anestesia, en calidad de pacientes de consultorio. Se midieron las concentraciones de glucosa en su plasma después de la inducción de anestesia. La concentración media de glucosa en su plasma fue de 4,70 mmol litro$^{-1}$. Ninguno de los pacientes tuvo una concentración de glucosa en su plasma que fuera inferior a 2,8 mmol litro$^{-1}$, a pesar de un ayuno de por lo menos 8 h. Esto queda por resolverse. Se sugiere que las conclusiones formadas a base de los estudios de que fueron objeto los pequeños pacientes hospitalizados, probablemente no sean aplicables a los pequeños pacientes de consultorio.