

It is likely that all the observed differences in glucose tolerance are due to changes in the rate of gastric emptying. Preliminary unpublished studies of our own indicate that after either Polya gastrectomy or vagotomy and pyloroplasty the emptying rate of a liquid glucose meal is much faster in the sitting than in the supine position.

After surgery for gastric ulcer neither peak blood glucose nor the degree of reactive hypoglycaemia was affected by posture. On inspection of individual results, in one of the two patients who had a Polya gastrectomy there was a postural change in glucose tolerance. Our unpublished studies of gastric emptying indicate that the absence of a postural effect on glucose tolerance in the group as a whole is due to the different type of gastrectomy (Billroth I), which is not associated with the rapid emptying seen after either the Polya procedure or vagotomy and pyloroplasty. This is consistent with other evidence that changes in the rate and pattern of gastric emptying after surgery are largely responsible for postgastrectomy reactive hypoglycaemia. In a previous paper suggesting this (Holdsworth *et al.*, 1969) we did not specify the position of the patients during oral glucose tolerance tests. They were in fact supine, which probably explains the mild degree of reactive hypoglycaemia observed in the study. In numerous papers devoted to the study of postoperative glucose tolerance the position of the patient is likewise not stated, and may account for the variable frequency of reactive hypoglycaemia in different reports.

Abnormal glucose tolerance has from time to time been reported in patients with peptic ulcer, and it is possible that these, too, are caused by changed gastric emptying. Platt *et al.*,

(1949) found higher peak blood glucose levels in duodenal ulcer patients after oral glucose than in controls, and although this was not confirmed by Buchanan *et al.* (1967) these workers found higher plasma insulin levels in duodenal ulcer subjects after oral glucose. Gastric emptying of a solid meal is faster in subjects with a duodenal ulcer than in normal subjects (Griffith *et al.* 1966) and if this is the case of oral glucose rapid gastric emptying could explain the reports of abnormal oral glucose tolerance curves in duodenal ulcer. In the present studies there are too few gastric ulcer subjects to make a valid comparison with the duodenal ulcer subjects, especially as no attempt was made to match them for age, sex, or weight.

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### References

- Buchanan, K. D., McKiddie, M. T., Lindsay, A. C., and Manderson, W. G. (1967). *Gut*, **8**, 325.  
 Griffith, G. H., Owen, G. M., Kirkman, S., and Shields, R. (1966). *Lancet*, **1**, 1244.  
 Herbert, V., Lau, K. S., Gottlieb, C. W., and Bleicher, S. J. (1965). *Journal of Clinical Endocrinology*, **25**, 1375.  
 Holdsworth, C. D., Turner, D., and McIntyre, N. (1969). *British Medical Journal*, **4**, 257.  
 McKelvey, S. T. D., Connell, A. M., and Kennedy, T. L. (1969). *Gut*, **10**, 1047.  
 Platt, W. D., jun., Dotti, L. B., and Beekman, R. S. (1949). *Gastroenterology*, **13**, 20.

## Head Injuries in Children

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### Summary

Two-hundred children with head injury admitted consecutively to paediatric wards in the two main hospitals in Newcastle upon Tyne have been studied. Eight children required neurosurgical operation. There were two deaths. Details of the cause and consequences of the accidents have been analysed and an attempt has been made to identify psychological or physical factors that may predispose to injury. There was a slightly higher proportion of children with what are regarded as adverse personality factors among the head injuries than in a control group and there were more left-handed children than would be expected in the general population. The results suggest that the modern "high-rise" bicycle may carry a special risk of head injury.

### Introduction

Beyond the first year of life the main cause of death in children is accident. It has been estimated that one in 10 of the child population of the United Kingdom has a serious accident every

year, the annual total being greater than a million (Court and Jackson, 1972). Many accidents result in head injury, which is the principal cause of admission of children to hospital after trauma (Rickham, 1961). In the hospitals in Newcastle upon Tyne there has been a sixfold increase in the past 20 years in the numbers of children admitted with head injury (Fig. 1), and in 1971 these accounted for 13.9% of all admissions to the paediatric wards of the two major hospitals in the city. A number of factors in addition to the real rise in accident rate may have contributed to this increase, but its implications for the hospital service are obvious.

There have been several extensive surveys of head injury in childhood (Burkinshaw, 1960; Partington, 1960; Hendrick *et al.*,

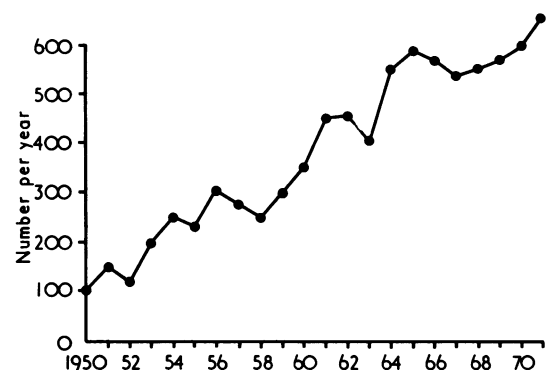


FIG. 1—Paediatric head injury cases admitted to hospitals in Newcastle upon Tyne 1950-71.

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1964; Klonoff and Robinson, 1967), and these were reviewed by Rune (1970). Most were based on retrospective analyses, and detailed information on the epidemiology of such injuries is scarce. In parallel with an adult survey at present in progress in Newcastle we have therefore undertaken a study in children in an attempt to learn more of the nature and cause of head injury, of its late sequelae, and of possible predisposing factors both psychological and environmental.

**Patients and Methods**

The study began on 1 November 1971. During the first three and a half months 200 patients were admitted, and the present report is based on an analysis of these cases. All children admitted to hospitals in Newcastle upon Tyne with a history or clinical evidence of a blow on the head, or with multiple injury that involved severe head injury, were included in the study. The ages ranged from 9 days to 14 years 7 months (mean age 5.7 years), and there were 131 boys and 69 girls. Altogether 95% were admitted as primary referrals from a child population estimated at 120,000. One of the hospitals on which the study was based (Newcastle General), however, includes the Regional Neurological Centre, and 10 of the 200 patients were admitted as secondary referrals from hospitals elsewhere in the region.

All children admitted to the study were examined while in hospital, and clinical data and details of neurological investigation and treatment were recorded. Parents were interviewed and information about previous behaviour patterns and about the accident itself was sought. In addition preaccident personality assessment of all the school-age children was obtained from teachers. For this purpose the behaviour inventory designed by Rutter *et al.* (1970a) for their survey of children in the Isle of Wight was used, and for each child control information was sought by asking the teacher to complete an assessment form for the child of the same sex next in alphabetical order in the class register. The Rutter questionnaire includes 26 items and refers to common neurotic and antisocial forms of behaviour such as fidgeting, nail-biting, bullying, and stealing. Each item is scored on a 0-2 scale and the aggregate represents the personality index.

**Results**

Twenty-eight per cent. of the injuries occurred in infants below the age of 3 (see Fig. 2). There was a striking rise in incidence at the age of 5, but beyond 6 the numbers tended to fall. Below the age of 6 there was only a slight preponderance of male injuries (1.2 to 1), but in children of 6 years and above the ratio increased to 3 males to 1 female. The overall ratio in the whole series was 1.9 males to 1 female.

**Timing of Accidents.**—In line with previous studies there was a high incidence of accidents on Saturdays (Fig. 3); however, there was also an unexpected peak on Thursday, 22% of the

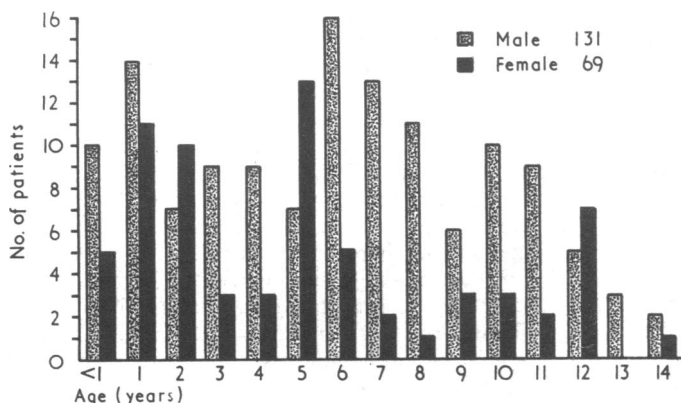


FIG. 2—Age and sex distribution in 200 paediatric head injuries.

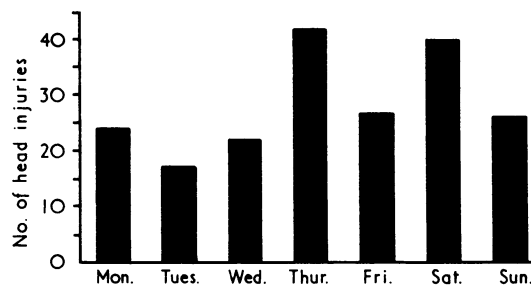


FIG. 3—Day on which head injury occurred.

total occurring on that day. The fact that Thursday is pay-day for many workers in the region and that it is late-night-shopping day may be relevant. Another possibility is that a larger number of children are brought straight to hospital because many family doctors take their half-day on Thursdays. The commonest times for injury were mid-morning and mid-afternoon, when children are out playing (Fig. 4). The six injuries that

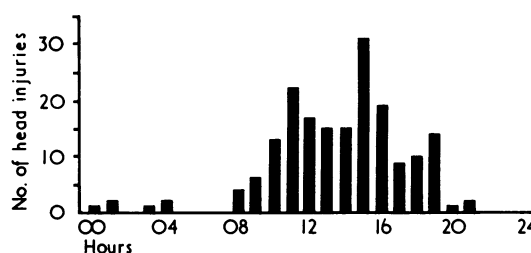


FIG. 4—Time of day head injury occurred.

occurred between midnight and 04.00 hours all resulted from assaults by parents.

**Type of Accident.**—Thirty-three per cent. of the head injuries (66) resulted from road accidents. These were uncommon below the age of 4, and beyond 9 the incidence tended to fall (Fig. 5). There were 45 pedestrian, 16 cycle, and 5 car-passenger accidents. Breakdown of the cycle accidents showed that 1 accident occurred on a tricycle, 4 on conventional bicycles, and no fewer than 11 on the new “high-rise” type of cycle. This is a machine with high handle-bars and a long seat with a back-rest on which the rider sits with the centre of gravity over the back wheel. Home accidents, which constituted 27.5% of the total, involved children mainly below the age of 3. They included falls from windows and chairs and accidents on

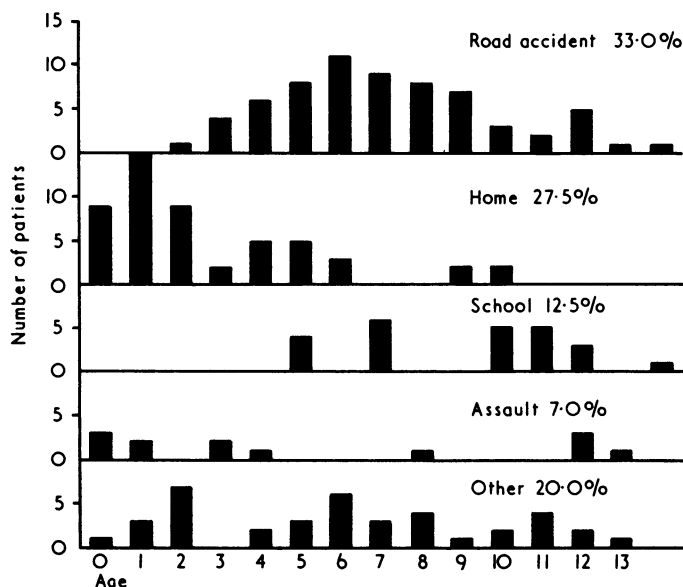


FIG. 5—Type of accident.

stairs. A relatively small number of injuries (12.5%) was sustained actually during school hours. In the whole series there were eight "non-accidental injuries" (battered-baby syndrome). One of these children died and one had bilateral subdural haematomas. The remainder in the group of assaults suffered their injuries in fights with other schoolchildren but none was very severe. The residual 20% of injuries were the result mainly of accidental falls and missile wounds.

**Length of Stay in Hospital.**—Altogether 149 of the children (74.5%) were discharged from hospital within 48 hours and 33 (16.5%) were discharged within three to seven days; thus 91.0% were in hospital for less than a week. Eighteen children (9%) were detained for more than a week, but in most cases it was their other injuries that delayed discharge.

**Severity of Head Trauma.**—Two children died, one from parental assault and the other as a result of multiple injuries suffered when he was knocked down by a car. The series, of course, takes no account of accidents resulting in death before admission to hospital. The duration of coma in the 31% who lost consciousness and survived is shown in Table I. In most cases the period was less than 10 minutes. There were 35 patients with skull fractures (17.5%), and of these six were depressed. Details of the eight neurosurgical operations that

TABLE I—Duration of Coma

Duration of coma No. (%) of children	<10 min 53 (26.5)	10 min—6 hr 9 (4.5)	>6 hr 1 (0.5)	Total 63 (31.5)

TABLE II—Neurosurgical Operations

	No.	%
Elevation of depressed fracture	2	1.0
Exploratory burr holes	3	1.5
Evacuation of extradural haematoma	2	1.0
Evacuation of bilateral subdural haematoma	1	0.5
Total	8	4.0

were performed are given in Table II. Four children were discharged from hospital with severe neurological deficit, but in the majority recovery after head injury was rapid and complete.

**Analysis of Pre-accident Personality.**—There were 114 children attending school, and for each a Rutter teacher assessment form was completed. Four teachers felt unable to provide information on a control child in the class and therefore pre-accident personality scores with controls for comparison are available on 110 children (Fig. 6). There were 15 in the head-injury group with scores greater than 12 in contrast to three in the control group, the difference being significant ( $P < 0.01$ ). One patient and his control were from a school for maladjusted children, and both scored more than 12.

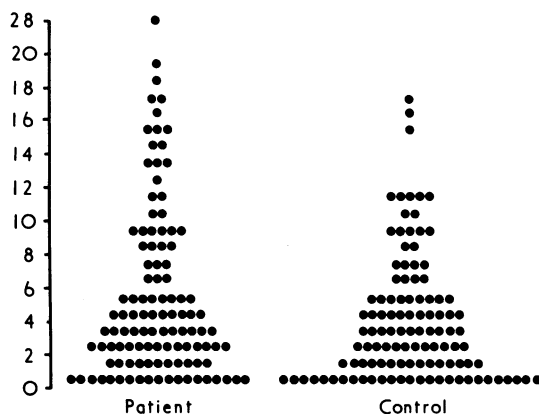


FIG. 6—Scores on Rutter behaviour inventory of 110 children with head injury and controls.

**Left-handedness.**—Among the school-age children with head injuries 17.6% were left-handed, whereas the incidence of left-handedness in the population is generally held to lie between 4% and 8%. The Medical Research Council national survey reported an incidence of 5.9% (Douglas *et al.*, 1967), and Rutter *et al.* (1970b) found that 4.1% of children in the Isle of Wight survey were left-handed.

## Discussion

The persistently high accident rate in children is a cause for concern, and to achieve an enlightened policy of prevention as much information as possible must be obtained about the causes and the predisposing factors. The present study is based on an analysis of head injuries occurring only during winter months, and it is appreciated that there is a seasonal variation mainly related to school holidays and hours of daylight. While this would probably alter the proportions of the various types of accident it seems unlikely that the predisposing factors under discussion would be influenced greatly.

In this series of head injuries a third, including one fatality, resulted from road accidents. Most occurred when young children were on the roads on foot and unaccompanied, but there was a large number of cycle accidents. One striking finding was that 11 (69%) of the 16 cycle accidents occurred in children riding the new style high-rise machine, although figures obtained from local schools, retailers, and road safety officers indicate that less than 20% of children's bicycles are of this type. The majority of these accidents occurred shortly after the purchase of the new bicycle. Anxiety has already been expressed by organizations concerned with accident prevention about the stability of these cycles, and our figures raise doubt about their safety. It seems that because of the weight distribution and the high handle-bars the front wheel tends to lift and steering is impaired. Furthermore, the long seat invites "unauthorized passengers," and in two of the accidents in the series there were two children on one bicycle. Waller (1971) reported no special hazard from these machines in a study in the U.S.A. of bicycle accidents of all types, but his figures did suggest a higher proportion of head injuries among children riding high-rise cycles. Our figures are not large enough to warrant definite conclusions, but a further study of the problem is in progress.

The present figures again illustrate the hazards that exist in the home for toddlers, and these could surely be reduced by more effective protection of stairs and windows. The distressingly high incidence of parental assaults reflects the magnitude of a serious problem which has been appreciated only in the past few years. All the children damaged in this way had severe injuries, and this is the general rule; unless the situation is grave it is unlikely that the child will be taken to a doctor, and nearly always there is delay in doing so. With only a few exceptions the other injuries in the series were mild, and most of the children went home shortly after their accidents, having apparently fully recovered without any residual ill effects. We are not yet in a position to report on possible late sequelae, but all the children are being followed up so that these will be detected if they occur.

The concept of accident-proneness has excited interest and controversy for many years. We hesitate to draw any firm conclusions from our small sample, but the excess of children in the head-injured group over controls who had high scores on the Rutter index suggests that there may be identifiable predisposing characteristics; it seems unlikely, however, that their recognition could lead to any useful preventative measures. Likewise the slightly high incidence of left-handedness in our head-injured group may be significant, although this could simply reflect the disadvantages for the sinistral of a right-handed world.

Only a small number of children in this series required neurosurgical investigation or treatment, and we have no special

comments to make on management; this was discussed in detail by Jennett (1972). Nevertheless, although a relatively small percentage need neurosurgical intervention it may be life-saving for those who require it, and there is no certain way of identifying them beforehand. The policy of admitting large numbers of children as a precautionary measure has therefore to continue, and clearly head injury, although a relatively small burden on the neurosurgical services, must inevitably make heavy demands on paediatric beds. On grounds of both expediency and humanity there is need for continued effort to reduce the risks of injury in children.

We gratefully acknowledge the support of the Newcastle Regional Hospital Board in our head-injury studies including the provision of a research registrarship for A.W.C. Mr. A. McNay gave invaluable help, and we thank Professor D. Court, Dr. G. Davison, and all the paediatricians and neurosurgeons who co-operated with

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## References

- Burkinshaw, J. (1960). *Archives of Disease in Childhood*, 35, 205.  
 Court, S. D. M., and Jackson, A. (1972). In *Paediatrics in the Seventies*. London, Oxford University Press.  
 Douglas, J. W. B., Ross, J. M., and Cooper, J. E. (1967). *Educational Research*, 9, 223.  
 Hendrick, E. B., Harwood-Hash, D. C. F., and Hudson, A. R. (1964). *Clinical Neurosurgery*, 11, 46.  
 Jennett, B. (1972). *Developmental Medicine and Child Neurology*, 14, 141.  
 Klonoff, H., and Robinson, G. C. (1967). *Canadian Medical Association Journal*, 96, 1308.  
 Partington, M. W. (1960). *Archives of Disease in Childhood*, 35, 215.  
 Rickham, P. P. (1961). *Helvetica Chirurgica Acta*, 56, 560.  
 Rune, V. (1970). *Acta Paediatrica Scandinavica*, Suppl. No. 209.  
 Rutter, M., Tizard, J., and Whitmore, K. (1970a). In *Education Health and Behaviour*. London, Longman.  
 Rutter, M., Graham, P., and Yule, W. (1970b). In *A Neuropsychiatric Study in Childhood*. London, Heinemann.  
 Waller, J. A. (1971). *Pediatrics*, 47, 6.

# Technetium-99<sup>m</sup> in the Diagnosis of Thyrotoxicosis

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## Summary

The thyroid uptake at 20 minutes of intravenously administered Technetium-99<sup>m</sup> (<sup>99m</sup>Tc) was measured in 117 patients with a standard scintillation counter. Patients were divided into three groups on the basis of clinical assessment, four-hour <sup>131</sup>I uptake, triiodothyronine (T-3) resin uptake, and protein-bound iodine measurements.

In 31 patients with no evidence of thyroid disease the mean <sup>99m</sup>Tc uptake was 1.8% ± S.D. 1.1%. In 32 patients with thyroid enlargement who were euthyroid the mean uptake was 2.5% ± S.D. 2.2%. In 54 thyrotoxic patients the mean uptake was 17.7% with a range of 4.1 to 44%, all cases having an uptake above the upper limit of normal (4.0%). These results agree closely with reported uptake studies using scanning techniques. In seven patients the extrathyroidal neck activity was measured by using a scanner, and the mean was 6.3% of the extrathyroidal total body radioactivity comparing favourably with an assumed 6% used in our calculations.

We have shown that the measurement of the thyroid uptake of <sup>99m</sup>Tc with a scintillation counter is of value, and that it is not necessary to use scanning techniques in the diagnosis of thyrotoxicosis. Advantages of <sup>99m</sup>Tc are minimal radiation, reduction in patient and laboratory time, and low cost.

## Introduction

Harper *et al.* (1962) first showed that Technetium-99<sup>m</sup> (<sup>99m</sup>Tc) was concentrated in the thyroid gland, and because of its short half-life of six hours its ready availability and desirable radiation characteristics suggested that it might be used for thyroid scanning.

Since then a number of workers have shown that excellent thyroid scans can be obtained with <sup>99m</sup>Tc (Andros *et al.*, 1965; Degrossi *et al.*, 1965; Kuba *et al.*, 1966; Atkins and Richards, 1968; Haas *et al.*, 1968; Umek and Czembirek, 1968; Crema *et al.*, 1969). Technetium is trapped by the thyroid, as is iodide, but soon after administration no significant organic binding takes place (Andros *et al.*, 1965; Shimmins *et al.*, 1968; Shimmins *et al.*, 1969). Burke *et al.* (1972) suggested that some binding of <sup>99m</sup>Tc may take place in thyrotoxic patients as there is less discharge of <sup>99m</sup>Tc from these as opposed to euthyroid subjects after perchlorate. Twenty minutes after intravenous injection, however, there is a very good correlation between the thyroid uptakes of <sup>131</sup>I and <sup>99m</sup>Tc (McGill *et al.*, 1971).

Early uptake studies of <sup>131</sup>I have been shown to be helpful in the diagnosis of thyrotoxicosis (Goolden, 1960) but they have not become generally used, partly perhaps because of the necessity to administer the isotope intravenously. Because of its short half-life and reduced radiation to the patient <sup>99m</sup>Tc has obvious advantages over <sup>131</sup>I, and, furthermore, unlike <sup>131</sup>I, which emits high energy gamma rays, <sup>99m</sup>Tc can also be used for scanning.

A number of reports have appeared showing that early uptake studies of <sup>99m</sup>Tc by the thyroid would differentiate thyrotoxic from euthyroid patients (Kuba *et al.*, 1967; Atkins and Richards, 1968; de Garreta *et al.*, 1968; Höschl and Gimlette, 1971; McGill *et al.*, 1971), but Goolden *et al.* (1971) were the first to advocate its routine use as a test of thyroid function. One of the main difficulties of early thyroid uptake studies is that extrathyroidal neck radioactivity (E.N.R.) makes a significant contribution to the neck uptake, and most of the previous workers have used scanning techniques in order to make a correction for this. Goolden *et al.* (1971) used a dual-head scanner, although they have shown since (Williams *et al.*, 1972) that similar results can be achieved with a single detector scanner. Because of the disadvantages of scanning McGill *et al.* (1971) did not recommend the uptake of <sup>99m</sup>Tc for routine clinical use.

We have devised a method for measuring the uptake of <sup>99m</sup>Tc with a standard scintillation detector that gives satisfactory results.

## Methods

30 μCi of <sup>99m</sup>Tc was injected intravenously and activity was counted 20 minutes later by using a directional (Ekco) scintilla-

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