Table 1—*Blood donors' responses to actual and hypothetical transfusion scenarios*

	Agree (%)	Maybe (%)	Disagree (%)	Don't know (%)
Because of health service user charges I have reconsidered donating blood	10	10	74	6
If the health services recover only the cost of processing blood, so that a profit is not made, I would continue to give my blood	83	7	6	4
If a profit was made from selling blood products I would not continue to give my blood	41	11	23	25
If I were offered expenses to compensate for my time in giving blood I would not accept it	47	26	7	20
If some blood donors in New Zealand were paid for giving blood I would still volunteer to give blood	76	7	6	11
If I were offered money for giving blood I would still want to give blood	75	7	11	7
If people were paid to give blood the quality collected may be reduced	48	23	20	9

donors (87% had been donating for over a year and almost half for over 10 years). Just over half were men (52%), but Europeans (93%, P<0.0005), professionals and managers (48%, P<0.0005), and the employed (97%) were overrepresented compared with the general population. Most people (89%) gave blood for a "general desire to help people." Other reasons were to repay a transfusion given to someone they knew (8%) or to themselves (5%), or because of future need or a family tradition.

Donors were asked about actual and hypothetical situations in relation to the reformed transfusion services (table 1). There was opposition to profit being made from blood, with 52% of donors unlikely to continue donating if this occurred, and even cost recovery alone was opposed by 13%. As a result of the introduction of user charges 20% of donors had reconsidered their donations; 71% of donors expressed concern about the quality of blood in a more commercial service.

Comment

Opinions of New Zealand donors, who have experienced the privatisation of many public sector agencies and the introduction of user charges for health care, are more pecuniary and divided than those of Titmuss's donors. Increasingly being asked to bear the costs of services, many donors would find it acceptable to be offered payment. While some donors voiced concerns about the introduction of market mechanisms in the blood service, most had long established patterns of donating, which they valued. As suggested by some authors, it may be possible, and desirable, to combine altruistic and pecuniary motives in the donor population.[4,5] If even a small number of donors cease donating, however, there are policy implications. Donor numbers have been hard to maintain, and even a 10% reduction would severely compromise the service. We are aware that a higher proportion of donors than usual have resigned since the introduction of the 1993 health reforms. This group is the subject of a separate study.

A recent report from Iowa suggests that blood quality is not compromised when rigorously selected paid donors are used, but most of our donors had serious concerns about quality in a commercially driven blood service. If this concern is shared by the general public commercial changes in blood transfusion services may be met with public opposition. Embedding transactions that rely so heavily on altruism in commercial organisations endangers the nature of the gift. Whether there will be compensating factors such as greater efficiency or the attraction of sufficient new, high quality donors is not clear.

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Conflict of interest: None.

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Low triiodothyronine concentration in preterm infants and subsequent intelligence quotient (IQ) at 8 year follow up

A Lucas, R Morley, MS Fewtrell

Infant and Child Nutrition Group, Medical Research Council Dunn Nutrition Unit, Cambridge CB4 1XJ
A Lucas, *head*
R Morley, *MRC clinical scientist*
MS Fewtrell, *MRC training fellow*

Correspondence to:
Professor Lucas.

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Prematurity is associated with clinically important changes in endocrine physiology. We have reported reduced plasma concentrations of many hormones in premature compared with full term infants, including prolactin,[1] testosterone,[2] and, notably, triiodothyronine.[3] Thyroid hormones are critical signals for brain development.[4] We showed a reduction of 7-9 points in scores in standardised mental and motor development tests at 18 months of age in preterm infants, even after adjustment for potential confounding factors.[3] As cognitive function at 18 months may not reflect later intelligence quotient (IQ), we measured IQ in the same group of preterm infants 7.5-8 years later when scores are likely to reflect adult values.

Subjects, methods, and results

We measured plasma triiodothyronine concentrations longitudinally in 279 infants in samples taken at 1-3 days and 4-7 days and then weekly until the infant was discharged from hospital or weighed 2000 g.[3] IQ was assessed in 236 infants (94% of survivors) at 7.5-8 years by means of an abbreviated version of the revised anglicised Weschler intelligence scales for children, which has five subscales and a correlation with full scale IQ of 0.96. In those children whose minimum triiodothyronine concentration was below 0.3 nmol/l[3] we found substantial deficits in IQ scores, even after adjustment for birth weight, gestation, sex, and Apgar score at 5 minutes (table 1). The effect was independent of the duration of artificial ventilation.

Controls (infants with normal neonatal triiodothyronine concentrations) had a longer gestation than infants with low triiodothyronine concentrations (cases) (30.8 (SD 2.4) *v* 28.9 (2.0) weeks) and higher birth weights (1393 (256) g *v* 1189 (300) g). In a subsidiary analysis we matched two controls to each case for birth weight and gestation (28.7 *v* 28.9 weeks) and the cognitive deficits of the cases remained unchanged.

Table 1—*Adjusted* deficit in intelligence quotient (IQ) at 7.5-8 years in children with low triiodothyronine concentrations neonatally*

	Mean (SE) deficit with lowest T3 <0.3 nmol/l neonatally	95% Confidence interval for deficit	P value
Weschler intelligence scales for children†:			
Overall IQ	6.6 (3.0)	0.7 to 12.4	0.03
Verbal IQ	8.5 (3.6)	1.5 to 15.5	0.02
Performance IQ	5.0 (3.0)	−0.9 to 11.0	0.10

T3 = triiodothyronine concentration.
*For sex, gestation, birth weight, Apgar score at 5 minutes, and days of ventilation (stepwise multiple regression analysis).
†Revised anglicised version with five subscales—vocabulary, similarities, arithmetic, block design, and object assembly.

Comment

The adjusted deficit in IQ with a low triiodothyronine concentration was 6.6 points, with an 8.5 point deficit on the verbal scale. A causal relation is suggested by the size of the association, its persistence after adjustment for confounding factors, and its plausibility given the known relation between neonatal hypothyroidism and impaired brain development.

Our findings do not provide information about the causes of the low triiodothyronine concentrations in preterm infants. We could not measure other thyroid hormones in these infants because of low sample volume, and so we cannot speculate whether the low triiodothyronine concentrations reflect decreased tissue deiodination of thyroxine or a general reduction in thyroid hormone production by the hypothalamic-pituitary-thyroid axis. This distinction would be relevant to the type of thyroid replacement treatment tested in any future trial.

Our results should be viewed as part of the broader endocrinopathy of prematurity. We previously found that reduced plasma prolactin concentrations were associated with an increased requirement for ventilatory assistance, a longer time to establish enteral feeding, and failure to grow in length—findings consistent with the known biology of prolactin.[1] We also observed attenuation of the two normal postnatal surges in testosterone concentration, at birth and around 2 months, in boys who had persistent undescended testes, which is common in preterm boys and a potential risk factor for later seminoma.[2]

The long term effects of this early endocrinopathy involving several further hormones need exploration. Current interest focuses on the programming effects of events in fetal life or infancy on long term health and development.[5] Hormones are important biological mediators for such programming.[5] Derangements of critical endocrine signals during sensitive windows in early development could have a range of long term effects, as we have suggested here for thyroxine and brain development.

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Commentary: Do preterm infants need thyroxine replacement?

C G D Brook

The interpretation of thyroid function tests in babies, especially in premature babies, is difficult. In adults the thyroid gland secretes thyroxine which can be deiodinated peripherally to generate iodothyronines that are more (triiodothyronine) or less (reverse triiodothyronine) potent than the parent compound. Triiodothyronine has three to four times the metabolic potency of thyroxine, and 80% is derived from peripheral conversion, the remainder coming from the thyroid gland. In the fetus serum triiodothyronine concentrations are low throughout gestation because the fetus preferentially converts the thyroxine its own thyroid gland produces and that which it acquires from the mother to reverse triiodothyronine, which is inactive. Clearly there has to be a switch at birth but, as is so often the case, the preterm infant is somewhere between the fetus and the newborn infant.

There are two further confounding variables. Intracellular deiodination of thyroxine to triiodothyronine varies from tissue to tissue so the relative concentrations of the two hormones in blood do not necessarily correspond to the biological effects of the hormones. The reverse triiodothyronine in the fetus comes principally from the liver and the placenta; the fetal brain does have the deiodinase capable of converting thyroxine to triiodothyronine, but whether it does so is unknown. The other problem is that thyroid hormones are almost completely bound to specific transport proteins so there is potential for confusion in measuring total rather than free thyroid hormone concentrations in preterm babies in whom plasma protein concentrations may vary. We know little about thyroid binding proteins (other than thyroglobulin) in preterm infants.

The consequences of congenital hypothyroidism are becoming clearer.[1 2] There is a discontinuous relation between IQ and plasma thyroxine concentration at diagnosis. A hypothyroid child with a serum thyroxine concentration less than 40 nmol/l is at risk of having a mean IQ 10 points lower than controls or a child with higher values. The IQ deficit measured at 5 years old in children with severe hypothyroidism persists at the age of 10 years.

The transient low thyroxine concentrations in very preterm infants is associated with developmental delay, so the finding of Lucas and colleagues that preterm infants with depressed plasma triiodothyronine concentrations subsequently had reduced developmental scores tallies with all of the available data. What can be done about it?

The administration of thyroxine to infants of less than 30 weeks' gestation does not increase plasma

Cobbold Laboratories, Paediatric Endocrinology, University College London Medical School, Middlesex Hospital, London W1N 8AA
C G D Brook, *professor of paediatric endocrinology*

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