average 0.5–1.0 cm taller and 0.5–1.0 kg heavier than the others. However, these differences were not significant (*t* test) at different ages or when all ages were combined (Table).

Table *Standard scores of height and weight of Jamaican children aged 6–12 years with AA and AS haemoglobin*

Genotype	n	Height score		Weight score	
		Mean	SD	Mean	SD
Boys					
AA*	266	0.00	1.00	0.00	1.00
AS	24	0.11	0.91	0.10	1.00
Girls					
AA*	279	0.00	1.00	0.00	1.00
AS	30	0.10	0.95	0.30	1.35

*Mean and SD are 0.00 and 1.00 by definition (see text).

Discussion

The results of the present studies agree with earlier observations in Jamaican children (Ashcroft *et al.*, 1976) and in Jamaican adults (Ashcroft *et al.*, 1969) that no significant differences exist between heights and weights of AS and AA subjects. The only long-term population study to compare the health of AS and AA subjects is one from Jamaica (Ashcroft and Desai, 1976). Mortality and morbidity were similar in 119 AS adults and 856 AA adults followed up for 12 years. The evidence therefore suggests that, with the exception of rare vascular occlusive episodes which may occur in severe anoxia, the AS genotype is benign and is not associated with abnormalities of growth.

Summary

No consistent differences were found in mean heights and weights of 170 schoolchildren aged 6–12 years with the sickle cell trait and 1247 schoolchildren with normal haemoglobin living in Dominica and Jamaica.

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Weaning very low birthweight infants from mechanical ventilation using intermittent mandatory ventilation and theophylline

The prognosis for very low birthweight infants with severe hyaline membrane disease (HMD) requiring mechanical ventilation has improved in recent years (Robertson and Tizard, 1975), partly because of improved ventilation technique (Kirby *et al.*, 1972; Reynolds, 1974). The duration of mechanical ventilation may still be protracted, particularly in very low birthweight infants. The ventilator dependence of some of these infants seems to be owing to inadequate ventilatory effort and therefore treatment with xanthines, which have been used effectively in neonatal apnoea (Shannon *et al.*, 1975), might facilitate their weaning from mechanical ventilation.

This report describes two very low birthweight infants with severe HMD who were weaned from mechanical ventilation using both continuous-flow intermittent mandatory ventilation (IMV) (Kirby *et al.*, 1972) and oral theophylline.

Case reports

Case 1. An infant born after 28 weeks' gestation and weighing 1090 g developed severe clinical HMD and at 11 hours progressed from endotracheal continuous-positive airway pressure (CPAP) to continuous-flow IMV using a pressure-limited, time-cycled ventilator * (Campbell, 1976). Arterial oxygen tension (P_{aO_2}) was greater than 50 mmHg (6650 Pa) in 25% inspired oxygen concentration by the 4th day, and normocarbica ($P_{aCO_2} < 45$ mmHg (5985 Pa)) on minimal IMV—peak pressure 20 cm H_2O , positive end-expiratory pressure 6 cm H_2O and frequency 6 cycles/min—was achieved on the 7th day. He breathed on CPAP for at least one hour (maximum $3\frac{1}{2}$ hours) on 19 occasions from the 8th to the 11th day; P_{aCO_2} was greater than 50 mmHg on 7 of 14 determinations made after a CPAP interval. On 3 other occasions, apnoea and bradycardia developed within 30 minutes of beginning CPAP; after the last of these episodes, which occurred on the 11th day, the IMV rate had to be increased to 10 cycles/min to maintain normocarbica and avoid bradycardia associated with hypopnoea. Plasma electrolytes and glucose were normal, there was neither systemic infection nor clinical persistence of the ductus arteriosus, and the lungs were radiographically normal. Oral theophylline, 1.8 mg/kg every six hours, was begun on the 12th day; within 14 hours he tolerated an IMV rate of 6 cycles/min without apnoea, bradycardia, or hypercarbia, and within 27 hours he breathed on CPAP without arterial blood gas or clinical need for IMV. He was extubated on the 13th day. The P_{aCO_2} during the 24 hours before theophylline was begun (42.4 ± 11.35 (mean $\pm$ SD) mmHg, $n = 10$) was not significantly different from that during the 24 hours after (46.2 ± 10.01 , $n = 8$). Theophylline was ceased on the 17th day at a time when there was no respiratory distress and arterial blood gases were normal in room air. Within 36 hours of theophylline being ceased, the infant was tachypnoeic with retractions and 30% inspired O_2 concentration was needed to maintain normoxaemia. Chest x-ray, which had previously been normal, showed 'hazy' lung fields, consistent with chronic pulmonary insufficiency of prematurity (Krauss *et al.*, 1975; Bednarek and Roloff, 1976). P_{aCO_2} during the four days before theophylline was ceased (36.0 ± 4.56 , $n = 9$) was significantly lower than that during the five days after (42.8 ± 6.08 , $n = 4$) (Mann-Whitney U test, $P < 0.05$). Plasma theophylline was not measured in this infant.

*Campbell Ventilator. Ulco Engineering Pty. Ltd, 21 Shepherd Street, Marrickville, NSW 2204, Australia.

Case 2. An infant born after 28 weeks' gestation and weighing 1170 g developed severe HMD and was begun on continuous-flow IMV at four hours. P_{aO_2} was greater than 50 mmHg (6650 Pa) in 25% inspired O_2 concentration by the 3rd day, and normocarbica on minimal IMV—peak pressure 16 cm H_2O , positive end-expiratory pressure 5 cm H_2O and frequency 6 cycles/min—was achieved on the 4th day. He breathed on CPAP for between one and two hours on five occasions on the 5th day; the P_{aCO_2} was less than 50 mmHg after each CPAP period but two periods terminated with apnoea and bradycardia. After the second of these episodes the IMV rate was increased to 12 cycles/min to avoid bradycardia with hypopnoea and maintain normocarbica. Plasma electrolytes and glucose were normal and neither systemic infection nor persistence of the ductus arteriosus was evident. Chest x-ray was abnormal, but the coarse reticular pattern present was not prominent. Oral theophylline, 2.0 mg/kg every six hours, was begun on the 5th day (Figure); within 5 hours he tolerated one-hour intervals of CPAP without apnoea, bradycardia, or hypercarbia and within 22 hours he was weaned to CPAP without need of IMV. He was extubated on the 7th day. P_{aCO_2} during the 24 hours before theophylline was begun and while on IMV (41.3 ± 4.07 , $n = 7$) was significantly higher than that after (34.2 ± 3.62 , $n = 8$; $P < 0.005$) (Figure). Theophylline was ceased on the 13th day. P_{aCO_2} during the five days before theophylline was ceased (33.8 ± 4.00 , $n = 11$) was

IMV=intermittent mandatory ventilation. Open histogram=IMV peak pressure (cm H_2O), closed histogram=IMV rate (cycles/min, cross hatched histogram=continuous-positive airway pressure (cm H_2O).

Figure (Case 2). P_{aCO_2} (mmHg) before and after theophylline had begun and ceased.

significantly lower than that during the six days after (48.3 ± 10.03 , $n = 6$; $P < 0.001$) (Figure). He did not require a higher ambient O_2 concentration and the chest x-ray was normal after theophylline was ceased. Plasma theophylline concentration on the 8th day was $17 \mu\text{g/dl}$.

Discussion

IMV (Kirby *et al.*, 1972)—augmentation of spontaneous ventilatory effort with a ventilator frequency sufficient to maintain normocarbica and prevention of CO_2 rebreathing by continuous gas flow—allowed recognition of dependence on low ventilator rates without which the two infants in this report developed apnoea or hypopnoea and bradycardia or hypercarbia. The minimal IMV and supplemental O_2 requirements to maintain normal arterial blood gases, and the normal or near normal chest x-rays suggested that the ventilator dependence of the infants was owing to inadequate ventilatory effort and not to pulmonary parenchymal disease. The relative ease with which they were weaned to CPAP and then extubated after treatment with theophylline supports this suggestion, since the drug is of proved value in the spontaneously breathing preterm neonate with apnoea (Shannon *et al.*, 1975).

The mechanism whereby xanthines exert their beneficial effect in neonatal apnoea is unknown, though they have been reported not to increase alveolar ventilation, since $Paco_2$ was unaffected (Shannon *et al.*, 1975; Bednarek and Roloff, 1976). However, the fact that in both infants $Paco_2$ was lower while they were receiving theophylline than after, and that in one infant $Paco_2$ was higher before theophylline was given than after, suggests an increase in alveolar ventilation during treatment with theophylline. The development of chronic pulmonary insufficiency of prematurity (Krauss *et al.*, 1975) after theophylline was omitted in one infant also suggests that theophylline may have an effect on alveolar ventilation, since the condition is characterised by low lung volume and ventilation/perfusion unevenness (Auld, 1975).

When very low birthweight infants recovering from HMD are dependent on slow-rate IMV without which they develop apnoea or hypopnoea and/or hypercarbia, treatment with theophylline may facilitate weaning from mechanical ventilation.

Summary

Two very low birthweight infants with severe clinical hyaline membrane disease requiring mechanical ventilation were dependent on slow-rate intermittent mandatory ventilation, without which

they developed apnoea or hypopnoea and hypercarbia. Their ventilator dependence was apparently owing to inadequate ventilatory effort, and treatment with oral theophylline allowed easy weaning to continuous-positive airway pressure and extubation. $Paco_2$ was significantly lower during theophylline treatment, suggesting that the drug may have improved alveolar ventilation.

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Right-sided congenital diaphragmatic herniae presenting as pleural effusions in the newborn: dangers and pitfalls

Early thoracentesis is recommended both for diagnosis and therapy in pleural effusions of the newborn. These case reports show the need for caution in placing a thoracostomy tube and describe the investigational pitfalls associated with this unusual presentation of right-sided congenital diaphragmatic hernia.