levels in the mother's milk and the complete resolution of symptoms and biochemical abnormalities once the infant's feeds were changed to a formula preparation confirmed the diagnosis.

The characteristic clinical features, the laboratory findings, and the probable pathophysiology of the condition have been well described by Grossman *et al.*[1] In their series all infants manifested anorexia, failure to thrive, microhaematuria, and low urinary chloride concentrations and most had metabolic alkalosis and hypokalaemia. The infant reported here presented with vomiting and dehydration on two occasions, and anorexia on another. He had not thrived well and had the typical serum and urinary biochemical findings but did not have microhaematuria.

There are few data regarding the daily chloride requirements in infancy. The recommended minimum chloride concentration for infant formulae (11 mmol/l) is based on the average levels found in human milk.[8] No explanation for the absence of chloride in this mother's breast milk was apparent. She appeared clinically healthy, was not on any medication (for example, diuretics) which might have affected the composition of her milk, and refused to allow further investigations to be undertaken on herself.

To our knowledge ours is only the second case of the dietary chloride deficiency syndrome so far reported in a breast-fed infant. We support the recommendation of Asnes *et al.*[3] that the diagnosis be considered in all breast-fed infants who fail to thrive. In addition it should be considered in all infants who have metabolic alkalosis and hypoelectrolytaemia particularly if the urinary chloride concentration is very low.

References

1 Grossman H, Duggan E, McCamman S, Welchert E, Hellerstein S. The dietary chloride deficiency syndrome. *Pediatrics* 1980; **66:** 366–74.

2 Roy S, III, Arant B S, Jr. Letter: Alkalosis from chloride deficient Neo-Mull-Soy. *N Engl J Med* 1979: **301:** 615.

3 Asnes R, Wisotsky D H, Migel P F, Seigle R L, Levy J. The dietary chloride deficiency syndrome occurring in a breast fed infant. *J Pediatr* 1982; **100:** 923–4.

4 Liddle G, Bledsoe T, Coppage W S, Jr. A familial renal disorder simulating primary aldosteronism but with negligible aldosterone secretion. *Trans Assoc Am Physicians* 1963; **76:** 199–213.

5 Calladine M, Gairdner D, Naidoo B T, Orrel D H. Acid-base changes following exchange transfusion with citrated blood. *Arch Dis Child* 1965; **40:** 626–31.

6 Veldhuis J D, Bardin C W, Demers L M. Metabolic mimicry of Bartter's syndrome by covert vomiting: utility of urinary chloride determinations. *Am J Med* 1979; **66:** 361–3.

7 Beckerman R C, Taussig L M. Hypoelectrolytemia and metabolic alkalosis in infants with cystic fibrosis. *Pediatrics* 1979; **63:** 580–3.

8 American Academy of Pediatrics: Committee on Nutrition. Commentary on breast-feeding and infant formulas, including proposed standards for formulas. *Pediatrics* 1976; **57:** 278–85.

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Received 4 November 1982

Making heel pricks less painful

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SUMMARY A mechanical lancet, the Autolet, was compared with a manual heel prick in 36 newborn infants undergoing routine blood sampling for the Guthrie test and hypothyroid screening. Each method was equally effective in obtaining satisfactory blood samples but the Autolet was considerably less painful.

It is common practice to take blood samples for laboratory examination in the newborn infant by heel prick. Small volumes of blood can often be analysed by micro methods, making venepuncture, which may be difficult and requires skill, unnecessary. The usual technique is to prick the infant's heel manually with a sterile metal stylet and then to squeeze gently until enough blood has been obtained. It is painful for the baby, and more than one prick may be needed to obtain enough blood, particularly if performed by an inexperienced operator. Many mothers also find the procedure distressing.

A mechanical device for capillary sampling, the Autolet (Owen Mumford, Woodstock, Oxford)[1] has recently become available. This device has been used successfully by diabetic children monitoring their own blood glucose at home.[2 3] The stylet is placed in a spring-loaded cartridge which is held against the skin. When the spring is released, the stylet pierces

the skin causing bleeding and is immediately withdrawn. The Autolet gives a fixed depth of puncture (2·4 mm).[4] This decreases the risk of calcaneal osteomyelitis. There is no control of depth with manual heel puncture.

Heel prick blood sampling is often performed in the newborn infant, for the Guthrie test, for screening for hypothyroidism, and for measuring levels of bilirubin, haemoglobin, and glucose. Samples are obtained by nurses, midwives, and doctors with a wide range of practical experience. For this reason we undertook a study to see if the Autolet was effective as a method of obtaining blood samples in the newborn and to assess the infant's reaction to it, compared with the usual manual method.

Method

The combined Guthrie test and hypothyroid screen was chosen for study because it is performed routinely on healthy mature infants of the same age, and because the amount of blood required is fairly large (150–200 μl). Heel pricks were performed by midwives using either of the two methods by random allocation. Sampling was continued until sufficient blood had been obtained to fill all 4 circles on the Guthrie filter paper card.

Sweating from the palm is related to emotional factors. It is increased by pain and anxiety and decreased by contentment and sleep. Palmar sweating has been used in adults to give an objective measure of emotional state. Our recent work[5] demonstrated that emotional sweating is present in mature newborn babies. The infant's reaction to the two methods of blood sampling was assessed by measuring palmar water loss using an evaporimeter (Ep1, Servomed, Sweden) as described.[5] The evaporimeter uses the water vapour pressure gradient close to the skin surface to estimate water loss from the surface. To take a measurement the evaporimeter probe was rested on the infant's open palm and water loss was recorded via a chart recorder while the infant was quiet or asleep before the heel prick. Recording continued while the heel was pricked and squeezed and did not finish until the infant had settled. A typical record of the emotional sweating which occurs in response to a painful stimulus is shown (Figure). The following were measured: (a) the time taken to obtain the full blood sample, (b) the time taken for the baby's palmar water loss to return to resting levels, and (c) the maximum rate of palmar water loss.

Results were analysed using Student's *t* test. Studies were performed on 36 healthy term infants

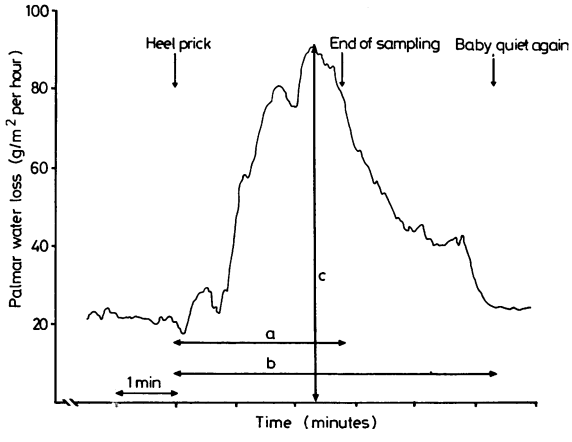

Figure *Change in palmar water loss in a newborn infant undergoing manual heel prick (a = time taken to obtain full blood sample; b = time taken for baby to settle; c = maximum recorded palmar water loss).*

Table *Results for the two methods of obtaining blood samples*

	Manual heel prick (n = 18)	*Autolet (n = 18)*
Time taken to obtain sample (mean and range)	3 minutes 33 seconds (1 minute–6 minutes 30 seconds)	2 minutes 54 seconds (1 minute–7 minutes)
Time taken for palmar water loss to return to resting levels (mean and range in g/m² per hour)	6 minutes (2 minutes 20 seconds–10 minutes)	2 minutes 54 seconds* (0–8 minutes 40 seconds)
Initial palmar water loss with infant quiet or asleep (mean and range g/m² per hour)	20 (12–31)	18·3 (10–30)
Maximum palmar water loss (mean and range g/m² per hour)	60·7 (27–114)	37·3* (18–85)

* $P < 0.005$.

on the 5th or 6th day of life. There were 18 infants in each group.

Results

Results are shown in the Table. In the Autolet group 3 infants did not wake at all during the procedure and a further 2, although awake, remained quiet with no increase in palmar water loss. There were no such infants in the heel prick group; in all infants palmar water loss showed a greater than 100% increase. Three infants in the manual group and 2 in the Autolet group required a second prick to obtain enough blood to fill in all 4 circles on the card.

Discussion

This study has shown that the Autolet is superior to the manual heel prick. Successful sampling was just as likely with the Autolet even though it was being used for the first time by many of the midwives. It was found to be popular, especially with the less experienced midwives who did not enjoy pricking heels.

The infants, too, preferred the Autolet method as judged by emotional sweating from the palm of the hand. Subjective assessment suggested that the infant cried less during the procedure and settled sooner. Indeed 3 of the 18 infants did not wake up. The Autolet heel prick is virtually painless; the discomfort of the procedure is largely due to holding the pricked heel while collecting the blood. After sampling with the Autolet the prick mark is virtually invisible. Repeat sampling—for example for frequent blood glucose estimations—is likely to cause less soreness of the heel.

We suggest that the Autolet method is an excellent way of obtaining heel prick blood samples in the newborn and could be used widely on postnatal wards, special care baby units, and neonatal intensive care units, in babies of any gestation.

We thank staff on the postnatal wards at the City Hospital for assistance. V A H was supported by a grant from the Medical Research Council of Great Britain.

References

1 Turner R C, Holman R R. Automatic lancet for capillary blood sampling. *Lancet* 1978; **ii:** 712.
2 Baum J D. Home monitoring of diabetic control. *Arch Dis Child* 1981; **56:** 897–9.
3 Baumer J H, Edelsten A D, Howlett B C, Owens C, Pennock C A, Savage D C L. Impact of home blood glucose monitoring on childhood diabetes. *Arch Dis Child* 1982; **57:** 195–9.
4 Blumenfeld T A, Turi G K, Blanc W A. Recommended site and depth of newborn heel skin punctures based on anatomical measurements and histopathology. *Lancet* 1979; **i:** 230–3.
5 Harpin V A, Rutter N. Development of emotional sweating in the newborn infant. *Arch Dis Child* 1982; **57:** 691–5.

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Received 1 September 1982

Progressive inflammatory subglottic narrowing responsive to steroids

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SUMMARY Four children aged between 2½ and 13½ years developed insidious subglottic stenosis of unknown cause over 3–12 months. In all, the initial diagnosis was asthma which resulted in inappropriate treatment. Endoscopically there was circumferential subglottic narrowing, and biopsy in 3 showed non-specific inflammatory changes. Corticosteroid therapy led to rapid and complete resolution.

Most cases of subglottic stenosis are the result of congenital malformations or of trauma from either an endotracheal tube or direct injury to the larynx.[1] Insidious onset subglottic stenosis due to perichondritis,[2] sarcoidosis,[3] and Wegener's granulomatosis[4] has been reported in adults but these do not seem to have been recognised in children. There is one brief report of insidious onset subglottic narrowing of obscure origin in 2 children.[5]

During the last 10 years, we have been concerned in the management of 4 children with progressive subglottic stenosis that did not seem due to any recognised disorder. In particular, the age at presentation and endoscopic and histological appearance were inconsistent with subglottic haemangioma which has been claimed to respond to corticosteroids[6] but which usually presents with progressive