FURTHER TECHNICAL PROBLEMS IN METABOLIC INVESTIGATIONS IN CHILDHOOD

BY

J. A. BLACK

From The Hospital for Sick Children, Great Ormond Street, London

(RECEIVED FOR PUBLICATION MARCH 14, 1951)

The purpose of this article is to describe two types of apparatus which have been found useful in the collection of urine from male and female infants, and also some modifications of the methods previously published from this unit (Edmunds, 1950). The method used for the male infants is based upon that described by Edmunds, but that used for the female infants employs a technique which does not appear to have been described previously.

The collection of urine from female infants has always presented considerable technical problems, and only two papers appear in the English and American literature on this subject. Cohen and Blatt (1940) in America described an apparatus for use with female infants employing a rubber unit with a recess tapered to form a funnel-like spout to which was attached glass tubing to be connected with a length of ordinary rubber tubing. In order to prevent faeces from being forced upwards into the collecting apparatus a small rubber button was made in the lower part of the apparatus to fit between the anal opening and the lower part of the vagina. We have not used this apparatus, though the method to be described also makes use of perineal pressure to divide the faeces from the urine. Four years later Thomson (1944) published a description of an apparatus for use with newborn infants. We have followed his description, but were unable to achieve satisfactory results in older infants. The method employs an ordinary rubber rat-tail aural syringe, in which is cut an oval hole to fit over the labia majora. We were unable to prevent contamination of the urine by faeces, and also felt that there was some risk of trauma from the hard rubber, as, in order to achieve a water-tight junction with the skin, considerable pressure had to be applied.

Apparatus for Collecting Urine from Male Infants

The method previously described by Edmunds has two disadvantages. Designed for use with premature

infants, it is only suitable for relatively immobile subjects, and requires the use of stockinette combinations with an elastic loop by which the glass collecting tube is fixed. For older children this is insufficiently rigid, and the

- A. SHOWING DISADVANTAGES OF THE ORIGINAL SHAPE OF GLASS TUBE.
B. SHOWING THE MODIFICATION OF THE ORIGINAL SHAPE.

FIG. 1.

shape of the glass tube is such that it cannot be used with the infant lying on its back, as may be necessary if an intravenous infusion is set up. Also the use of the combinations makes it difficult to splint the legs for intravenous therapy, and if an intravenous infusion is already running the combinations cannot be put on.

It was decided therefore that some form of apparatus might be designed for use with an ordinary mattress and cot; that is, for occasions when the collection of urine alone is required. The second requirement was that the apparatus should be capable of being set up without unduly disturbing an ill child on intravenous therapy.

To illustrate the principles involved in the design of the glass collecting unit for male infants Fig. 1 shows the difficulties in using a tube of the original shape with a child lying on its back on an ordinary mattress (one without any holes for the passage of tubes, etc.). The first difficulty is that with a tube with a right-angle bend all the pressure comes on the base of the penis at the junction with the scrotum. The second difficulty is that the rubber tubing has to be bent at a right-angle and is liable to kink or to push the glass tube upwards. A glass tube was therefore designed which exerted an equal pressure all round the base of the penis and whose long axis was more nearly parallel with the mattress.

The second problem of fixing the tube in position was solved by using an ordinary rubber hernia truss (Fig. 2). This is strapped round the lower abdomen in the usual way, but the two round rubber strips passing between the thighs are left as loose-fitting as possible. These rubber strips pass on either side of the glass tube and can be made to grip it tightly in position by tying them together below, and, if necessary, above the glass tube (Fig. 3). This method of fixation does not produce any undue pressure or discomfort and can be kept in place

for a number of days. For this method, as for others, using an ordinary mattress, it is of course necessary to tip the bed with blocks, and therefore the infant may

need to be anchored by pillows by pinning an abdominal binder to the bottom sheet, or by tying a restraining jacket to the sides of the cot.

Apparatus for Collecting Urine from Female Infants

The technique described has proved successful with a number of female infants varying in age from 3 months to 4 years, the oldest child being a severe ament with phenylketonuria. Some difficulty was experienced with a very oedematous girl with type II nephritis, and the use of the apparatus had to be stopped on account of the development of a superficial blister and oedema. Apart from this no ill-effects have been noted.

The first problem was to obtain an accurately fitting apparatus, as it was found that unless this was achieved there was always some leakage in the perineal region. The second problem was to find a substance which could be moulded accurately and conveniently. On the advice of the dental department of the hospital the plastic known as 'welvic' * P.V.C. paste (Baird, 1948) was used.

The technique adopted was as follows. A female infant of the required size was selected and a 'zelex' † impression was made of the whole of the perineal region, to include the labia majora and the anal orifice. From this impression a plaster model of the perineum was made and a wax prototype was built on this to fit exactly (Figs. 4 and 5). A mould was then made from the wax prototype and the liquid plastic was then poured into the mould and heated in an oven at 130° C. for 30 minutes.

FIG. 2.

* 'Welvic', polyvinyl chloride paste, is obtained from Imperial Chemical Industries Ltd. (Plastics Division).

† 'Zelex', alginate impression material, is obtained from the Amalgamated Dental Co., Ltd.

The shape of the apparatus is shown in the photographs and in Fig. 6, the main points being (1) an accurate fit at the region of the perineal body, (2) sufficient size to enclose the labia majora, (3) adequate capacity to take

FIG. 4.

up a rapid flow of urine without overflowing, (4) drainage from the most dependent portion of the apparatus, and (5) an air-outlet at the top of the apparatus.

It was at first thought that a new apparatus would have to be made for each child, but this has proved unnecessary as one size will fit children varying quite considerably in size and age. We have used three sizes only and have not yet had to make any intermediate ones. The plastic is quite soft, and even when applied

FIG. 5.

FIG. 6.

- A. SHOWING ORIGINAL DESIGN, WITH POINTS WHERE PRESSURE IS LIKELY TO OCCUR.
B. SHOWING THE MODIFICATION OF THE ORIGINAL DESIGN.

FIG. 7.

for periods up to four days has produced no trauma except in the oedematous child. The apparatus is held in place by a small binder with a hole through which passes the outlet tube (Edmunds, 1950). If used in an ordinary cot this has to be tipped, and the child's buttocks may have to be placed on pillows in order to provide sufficient clearance for the glass outlet tube. The only disadvantages of the P.V.C. paste are that it cannot be boiled, and is dissolved by acetone, chloroform, and similar substances. After use the apparatus is scrubbed with soap and hot water and can be sterilized by immersion in antiseptics of the 'dettol' type.

Recent Modifications in General Technique

Recently we have used a pre-vulcanized natural rubber latex ('vuljex'*) which has two advantages; first it sets without heating, and secondly it can be sterilized by boiling.

During the past year a number of modifications have been made in the techniques originally published from this hospital (Edmunds, 1950). Though they do not represent major alterations, it is felt that even small changes may make a great difference in the comfort of the child and in the success of the balance experiments.

Markers. It has been found more satisfactory to give carmine as a dry powder in a dose of 4 grains, as this is relatively tasteless compared to the solution originally recommended.

Collecting Urinal. This is designed for the metabolic bed. The original pattern fitting over the penis caused some discomfort by pressure and has been replaced by one fitting over the scrotum and penis. To prevent any

pressure in the dorsum of the penis a bulge has been made on the upper surface of the urinal (Fig. 7).

Canvases and Binders. A number of sets of canvases and binders have been made to fit children of different sizes. Pressure sores can be prevented by placing pads of gamgee tissue round the buttocks, thighs, and under the axillae, and rolls of napkins are placed under the thighs to prevent undue dragging on the binders round the thighs. Large blanket pins are stronger than any safety pins and cannot easily be swallowed.

Position of the Child. Many children can sit up on the bed with pillows behind the back if the top binder is removed during the day. This makes feeding and bringing up wind very much easier, and enables the children to take an interest in their surroundings.

Summary

The technique and apparatus used in the collection of urine from male and female infants are described, and also some recent modifications in general technique.

Acknowledgments and thanks are due to Professor Moncrieff and to Dr. W. W. Payne for their help and advice, to Sister Merrilees and her staff, to Mr. D. P. Walther, Orthodontic Registrar, to the technicians of the dental department, The Hospital for Sick Children, and to Mr. Derek Martin and to Mr. P. Cull (The Hospital for Sick Children) for the photographs and diagrams.

REFERENCES

- Baird, D. K. (1948). *Brit. Plastics*, **20**, 167.
 Cohen, R., and Blatt, M. L. (1940). *Amer. J. Dis. Child.*, **60**, 897.
 Edmunds, M. E. (1950). *Archives of Disease in Childhood*, **25**, 254.
 Thomson, J. (1944). *Ibid.*, **19**, 169.

* 'Vuljex', pre-vulcanized centrifuged natural rubber latex (type 5), is obtained from Wm. Symington & Son, Ltd., 36 Gracechurch Street, London, E.C.3.