Discussion

The nature of the epidemic suggests an infectious agent, presumably a virus, but, as in previous reports, it was not identified. We saw no babies under nine months and no adults with the disease, so it appears that erythema infectiosum is an infection by a common, contagious virus to which most people have developed immunity by adulthood, and from which babies are protected by transplacental endowment of maternal antibodies. Possibly many cases are seen but mis-diagnosed as either an allergic rash or another exanthem. We saw an example of this. A 7-year-old holidaymaker from Lancashire presented on arrival in our area at the end of the epidemic with a typical erythema infectiosum rash of several days' duration. En route she had been seen by two other doctors. One diagnosed scarlet fever and prescribed penicillin and the other an allergic rash and gave an antihistamine. Neither drug influenced the course of the disease.

Ager¹ quotes a female to male distribution of 3:2 but in our smaller series the ratio was reversed, while Edelson and Altman³ in a large series showed an equal sex distribution. In this epidemic the peak age incidence was 5-9 years, which agrees with that in other reports. Like Watts,^{6 7} we noted an incubation period of 22 days, but this is much longer than in other series: Ager *et al*⁵ suggest 7-11 days while Edelson and Altman³ suggest 4-14 days. The average duration of the disease in our series agrees with American findings but is at odds with the British figures given by Watts^{6 7} and Harries and Mitman.⁸

The question of teratogenicity has been raised by Ager *et al*.⁵ Their series included seven pregnant women but none had malformed babies. The rate of fetal abnormality in their area at that time was in fact lower than average. We will be taking particular note of infants born to mothers who were in the first trimester during the epidemic.

We are grateful to Dr R J C Hart, consultant virologist, Exeter, for drafting the viral studies section of this article and to his laboratory staff for their invaluable help. We also thank Dr W Burgess, consultant paediatrician, North Devon, who encouraged us to record this epidemic and gave us valuable guidance and criticism in preparing this paper.

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Hospital Topics

Defects in sphygmomanometers: An important source of error in blood pressure recording

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British Medical Journal, 1976, **1**, 886-888

Summary

Almost half the sphygmomanometers in a teaching hospital group had defects in the control valve which interfered with accurate blood-pressure reading. Ward staff should be taught to check sphygmomanometers regularly and replace control valves; time consumption and cost are low. The cuffs in general use in these hospitals, and of the standard size sold in Britain, had rubber bags which did not encircle the arm of more than half the patients on whom they were used. This deficiency causes over-reading of blood pressure in obese people. The size of error is uncertain but it should be avoided by adopting a cuff with a longer bag.

During the autumn of 1975 the Division of Medicine commissioned a study of diagnostic and therapeutic equipment on

the medical and geriatric wards of hospitals administered by the Newcastle Area Health Authority (Teaching). Defects in sphygmomanometers in use on these wards were so common that they cast doubt on the validity of blood pressure recordings on our patients. Since we believe that these defects are commonplace in British hospitals, and since the deficiencies can be remedied at very low cost, we report our findings.

Methods

Figure 1 illustrates the points that were checked on each sphygmomanometer. Our tests followed roughly the lines suggested by the Subcommittee on Blood Pressure Measurement of the American Heart Association¹ though we used a more stringent test for air leaks.

(a) The pump should have a competent non-return valve and no leaks.

(b) The control valve should allow the free passage of air without excessive muscular effort when the filter (fig 2) is clean. When closed it should hold the mercury at a constant level. When released it should allow a controlled fall of the mercury column. To test the valve we rolled the cuff in its own "tail," pumped to 200 mm Hg and waited 10 seconds, during which time the level should not fall more than 2 mm Hg. If a leak was detected the circuit was clamped in sections to find the site but in fact all such leaks were traced to control valves. We then slowly released the valve on four occasions. During at least two of these attempts it should be possible to control the rate of fall

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FIG 1—Points checked in each sphygmomanometer.

FIG 2—Sphygmomanometer control valve showing position of air filter (arrowed).

readily to not more than 1 mm/s and to change to and from a faster rate at will. Ideally this should be possible at every attempt but a more demanding test would result in our condemning nearly all our sphygmomanometers, including many new ones, with the present design of control valve.

(c) The connections should fit without an air leak and should come apart easily.

(d) The tube should be airtight and of appropriate length.

(e) The mercury tube should not be cracked. There should be a patent air-vent at the top of the column.

(f) The cuff should fit comfortably round the arm and stay in place when inflated. The rubber bag should be long enough to encircle the arm. To check this we measured the arm circumference of 250 inpatients and 250 outpatients attending medical clinics. Circumference was measured to the nearest half-centimetre at a point 14 cm above the elbow crease.

Results

The wards possessed 79 sphygmomanometers and 20 spare cuffs. A further seven machines were away for repair. From the descriptions of ward sisters it appeared that about half the defects which took machines out of commission were in the body work and about half in the control valve; the latter could have been corrected in a few minutes without sending the machine away if wards had kept a stock of control valves. Among the 79 machines in use, major defects were confined to valves and cuffs.

Control valves

Of the 79 valves tested, 42 functioned satisfactorily, 20 were leaky (could not hold the mercury steady), 13 were sticky (could not control the fall of mercury), and 4 were blocked. Of the 42 eight had excessive air resistance readily corrected by cleaning the filter (fig 2) of its fluff and rubber fragments, a procedure with which few ward staff were familiar.

Cuffs

Only six of the 17 wards had small cuffs for use on children or very small adults and in none of these were the cuffs so labelled. Two were

in general use on adult wards. Only the renal ward had a large cuff for use on thighs. The standard size of rubber bag now purchased by our hospitals is 22.9 × 12.7 cm (9 × 5 in). Of the 91 adult cuffs in use on our wards 73 were of this type and 16 were of an older design and about 1 cm less in each diameter. Only two arm cuffs had slightly larger bags and none was longer than 24 cm.

Arm size

The distribution of arm circumference is shown in table I. The age distribution of the population is shown in table II and the weight distribution in table III. Arm circumference was largely a function of body weight (fig 3).

TABLE I—Distribution of arm circumference in population studied (250 inpatients, predominantly old; 250 outpatients). A 36 cm bag would encircle 99% of arms

Arm circumference	≤19.5	20-23.5	24-27.5	28-31.5	32-33.5	≥34
Percentage of subjects (total 500)	3.0	14.6	41.4	33.2	5.6	2.2

TABLE II—Age distribution of population studied

Age	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
No of patients	31	78	59	91	96	84	49	12

TABLE III—Weight distribution of population studied

Age	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Mean weight (kg)	53.5	63.0	65.0	67.8	67.2	62.1	57.6	59.0

FIG 3—Relationship of arm circumference to body weight.

Discussion

Even when taken carefully, indirect blood pressure does not always reflect accurately the intra-arterial pressure.^{2,3} There is no point, however, in adding to this inevitable error the many avoidable errors of digit preference, sloppy procedure, and defective instruments.^{1,3-8} Blood pressure should be recorded to the nearest 2 mm Hg and for this it is essential that the mercury column should not fall by more than 2 mm per heart beat. An epidemiologist's sphygmomanometer⁶ incorporates a valve which limits the fall of the mercury to 2 mm/s but it is too cumbersome for routine clinical use. The standard control valve is acceptable provided it is changed as soon as the rubber seal becomes perished or dirty making the valve sticky or leaky. Several valves we tested, with which doctors and nurses were supposedly measuring blood pressure, could not control the mercury at better than 10 mm/s. A new valve costs 54p, yet we found no ward sisters who knew the simple procedure for testing

and replacing them or were aware that they could be obtained separately.

Prominent among other sources of error is disparity between the size of the cuff and the circumference of the arm. This was recognised in 1909⁹ and has been the subject of several careful studies.¹⁰⁻¹² None the less the *BMJ** takes a defeatist view: "The usual standard cuff of 12 × 33 cm is too short . . . though the suggestion that (a 12 × 35 cm cuff) is the correct standard seems unlikely to be followed widely in Britain, and we must accept that there is generally a small error." Certainly there is no likelihood of a 12 × 35 cm arm cuff being widely adopted in Britain since we have been unable to buy one, but we see no reason for accepting the error which is not always small. King's study¹² showed enormous errors when a very short bladder was employed so the mistaken use of paediatric cuffs on adults may introduce some wildly inaccurate readings; we suggest that such cuffs should be labelled for the sake of inexperienced nurses.

The standard cuff used by King¹² had a bag of 26 × 15 cm. Even with this there was a small but significant over-reading of blood pressure with arm circumference of 32 cm or above (8% of our patients). With a bag that completely encircled the arm King¹² found that width above 11 cm was not critical, but if length is deficient width becomes important and the World Health Organisation have recommended a 14 cm width.¹³ Pickering² has published a table of corrections for blood pressure readings on fat arms but it seems better to avoid the problem altogether by using a cuff with a bag 35-40 cm long. Overlapping of the bag in a thin arm does not introduce an important error.¹²

We cannot calculate from any published data the likely error introduced by the standard British cuff. On normal arms, as the *BMJ* implies, it is probably small. In the most obese 10% of our patients it must be higher than the few mm Hg found by King with his larger cuff.¹² If enough doctors asked for 35-40 cm cuffs manufacturers would start producing them. They might add £1-2 to the cost of a sphygmomanometer, a small price to pay for accuracy in one of the commonest and most important clinical measurements.

SC was supported by Grant CAPES—Coordenação no Aperfeiçoamento pessoal de Nivel Superior, Brasília, Brazil

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Problems of Childhood

Intoeing and flat feet

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British Medical Journal, 1976, **1**, 888-889

Intoeing

After flat foot and knock knee, walking with the toes turned in is the third commonest cause for parental concern when a child starts to walk. The parent may complain that the child turns his toes in or that he tends to throw one leg round the other or that he tends to fall over his own toes.

CAUSES

Two completely different causes for intoeing need to be distinguished from each other. In the commoner type, the deformity is not at the foot but above the knee—in other words, the child is walking with the whole limb turned medially. A less common cause for intoeing is a varus and adduction deformity of the foot. It is not difficult to distinguish the two conditions.

If the intoeing is due to medial rotation of the limb as a whole, the child walks with his knees facing a little towards each other and examination of the feet shows no abnormality of the foot itself. A child with varus and adduction of the forefoot (metatarsus varus) walks with his knees facing forwards or slightly outwards and the forefoot is turned medially relative to the hindfoot. The shoe shows a corresponding deformity. Inquiry from the parents will usually disclose that the foot deformity has been present since birth or at least recognised before the child started to walk.

Intoeing not associated with foot deformity is due to a medial torsion of the limb above the knee level. The possible causes for a medially rotated position of the limb could be that the acetabulum is facing more forwards than normal; that the femoral neck is abnormally anteverted; or that the femoral shaft has an abnormal degree of medial torsion—or there may be a combination of more than one factor. Fortunately, it does not matter much what the exact cause is because the abnormality almost always corrects spontaneously with growth. Confirmation that the rotation deformity is above knee level is given by lying the child down with his hips extended and testing the range of medial and lateral rotation. In a child from 18 months to 3 years medial rotation is not normally over 50° and lateral rotation not less than 40°. In a child who toes in medial rotation will be found to be 70° or more and lateral rotation 35° or less.

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