Current Practice

Transport of Sick Newborn Babies

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Summary: When sick newborn babies are transferred to Hammersmith Hospital they are collected from the referring hospital or from home by a paediatric resident doctor and a nurse. They prepare the baby for the journey by giving any urgent treatment required, for procedures are difficult to carry out in a moving ambulance. Babies who are likely to become apnoeic are intubated before transport so that ventilation can be started immediately if required. The baby travels in a portable incubator, and special attention is paid to prevention of hypothermia, adequate oxygenation, and respiration. Altogether 122 babies were transferred in 1969, the main reasons being prematurity, hyaline membrane disease, and apnoeic attacks. Five improved during the journey, 102 did not change significantly and 15 became worse. There was no evidence that travel per se harmed any of the babies, though in a few cases deterioration might have been prevented had observation and treatment been easier in the ambulance. Fifty-eight (47%) of the babies eventually died, but the group was a highly selected one with a high proportion of small, immature, and ill babies. We conclude that for very ill newborn babies the advantages of transfer to an intensive care unit probably outweigh the disadvantages of transport, provided that the precautions described here are taken.

Introduction

It is often said that sick newborn babies do not travel well; nevertheless, the increasing complexity of their treatment has inevitably led to some centralization of these services in intensive care units. As centralization progresses the number of ambulance journeys undertaken with neonatal patients will increase.

For the past three years it has been the practice at Hammersmith Hospital for a doctor and a nurse to go with the ambulance when a newborn baby is being transferred, so that the baby may be suitably prepared and attended before and during the journey. We have reviewed the problems concerning the 122 such admissions to the neonatal unit in 1969. These cases include virtually all patients for whom transfer was requested. Admission is not refused unless the ward is working to the limit of its capacity as regards either patient accommodation or staffing. Some cases with congenital cardiac defects were referred for investigation with a view to surgery, but apart from these no surgical cases are included.

Procedure

When we are asked to accept a newborn baby from another hospital we arrange for an ambulance to collect the doctor and nurse, together with the emergency equipment (see Table

I) and portable incubator, and then to proceed to the hospital requesting the transfer.

TABLE I.—*Contents of Emergency Case*

Laryngoscope with spare bulbs and batteries
Magill forceps
Oxygen tubing and blow-off valve, adjustable to blow-off between 10 and 60 cm. water
Nasal and oral endotracheal tubes and connexions
Suction catheters
Disposable mucus extractors
Stethoscope
Scissors
Ampoule file
Zinc oxide plaster
Syringes—assorted sizes
Needles
Scalp vein needles
Sterile gauze and cotton-wool
Isopropyl alcohol impregnated swabs (Mediawabs)
Umbilical catheters (feeding tubes sizes 8 and 5 French)
Silver swaddler
Urine collection bags
Thermometer (low reading)
Blood sample bottles
Dextrostix
Drugs:
Dextrose
Sodium bicarbonate
Trometamol
Nalorphine
Digoxin
Fruzemide
Adrenaline

Distance and Duration of Journeys.—Altogether 116 journeys were made to collect 122 infants. Six infants were collected from their homes, the remainder from hospitals or maternity homes. The distance from Hammersmith Hospital to the referring hospitals varied from 1½ to 34 miles (2 to 55 km.) with an average of 7 miles (11 km.). In general it took half to one hour to reach the referring hospital and a similar time to return. Up to two hours might be spent in assessing and resuscitating the baby before starting the return journey. We have been most impressed by the good humour and unfailing helpfulness of the ambulance crews. Nevertheless, crews who have not been to a particular hospital before often have difficulty in locating the entrance. Their maps do not seem to have been designed with this problem in mind. On one occasion a 20-minute search at 3 a.m. for a hospital outside London was ended only when a police car appeared and led us to the entrance.

Ambulance.—The babies are carried in an ordinary Greater London Council accident ambulance fitted with internal heaters and a 12-volt power point for the portable incubator. We feel that the ambulance is not the place for resuscitation because there is no well-lighted and warmed flat working surface and usually no mechanical suction. Furthermore, procedures are more likely to cool the baby if they are done in the ambulance rather than in a warm hospital ward. We therefore try to give any necessary resuscitation or treatment before the return journey starts.

Incubator.—We use an Oxygenaire mark III portable incubator, which is always kept warm and ready for use on the neonatal ward. As soon as the ambulance arrives at Hammersmith Hospital the incubator is plugged into its power point and is not disconnected at the referring hospital until

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the baby has been examined and is ready to be placed into it. During the journey the incubator is kept covered with a metalized blanket to prevent heat loss, and its internal temperature can be kept at about 96° F. (35.5° C.). The oxygen supply is from a 24 cu. ft. (0.7 cu. m.) cylinder; a spare cylinder is needed for long journeys.

Assessment and Treatment before Transfer

On arrival at the referring hospital we take a history of mother and baby on a standard "baby transfer form." Special attention is paid to the mother's obstetric history and drug therapy and to the baby's fluid intake, feeding, drugs, blood glucose estimations, apnoeic episodes, oxygen therapy, and temperature. When possible, notes and x-ray films are taken with the baby and returned on its discharge. The placenta is also taken if it is available. When a baby affected by rhesus disease is transferred a sample of maternal blood is obtained.

The baby is examined to decide whether treatment is required before transfer.

Intubation

Endotracheal intubation is carried out before transfer if the baby has an apnoeic attack which does not respond to stimulation and oxygen by face-mask. Intubation is also done "prophylactically" if it seems likely that it would otherwise become necessary on the journey—that is, in babies with a history of apnoeic attacks or with severe respiratory distress. We emphasize that prophylactic intubation is performed to cover only the period of the journey. A baby on the neonatal ward in a similar clinical condition would not be intubated. The disadvantages of intubation include increase and retention of secretions, abolition of grunting, with a consequent rise in PaCO_2 and a drop in PaO_2 ,¹ possible occlusion of a main bronchus, extubation problems, injuries to the airway, and production of pneumothorax or pneumomediastinum. We feel, however, that for the short period of the journey these disadvantages are outweighed by the avoidance of delay and difficulty if ventilation becomes necessary in the ambulance.

Fifty babies were intubated before transfer. Ten were intubated prophylactically, and three of these did, in fact, require intermittent positive-pressure ventilation during the journey. In all we gave 36 babies intermittent positive-pressure ventilation at a time other than immediately after intubation.

We normally use a 3-mm. white Portex nasotracheal tube, as this is more stable and easier to secure than an oral one. If an orotracheal tube is already in use it is replaced by a nasal one—this was done in 25 cases. Three babies were transported with oral tubes—one was affected by choanal atresia, in another nasal intubation was unsuccessful, and in the third case the oral tube became dislodged in transit (Case 14, Table VI).

The stomach is emptied before intubation is attempted, as gastric pooling and regurgitation often occur in sick babies. Though routine aspiration before transfer has been advocated,² we do not carry this out except in babies to be intubated, since in our experience vomiting during transit has not been a problem.

Hypoglycaemia

An estimation of blood glucose is made by Dextrostix³ in babies who are small for dates or who have been severely hypoxic. If the blood glucose is estimated as below 20 mg./100 ml. a sample of blood is taken into fluoride for a later biochemical estimation and 1 g. of dextrose is given slowly intravenously. This was done in eight babies, of whom one was small for dates, five had been asphyxiated, one was

both small for dates and had been asphyxiated, and one had respiratory distress alone.

Acidosis

In our experience rapid pH determination has not been possible at the time of initial assessment, though previous results are sometimes available. We therefore have to guess whether an infant is likely to be acidotic. If an infant has been severely anoxic intravenous alkali is given empirically. Sodium bicarbonate is normally used in a dose of 2–6 mEq/kg. If the baby has already had a high sodium intake or is oedematous trometamol (THAM) is used instead.

Umbilical Catheterization

When an umbilical venous catheter has already been inserted it is normally used for giving alkali or glucose if indicated. Otherwise these drugs are given into a peripheral vein. If this is found to be impossible and the drugs are needed urgently formal catheterization of the umbilical vein is undertaken with full sterile precautions. Unless umbilical drips are essential they are taken down before the journey starts and the catheter is filled with a heparin saline solution.

Eleven cases were transferred with an umbilical catheter in place. In seven cases the catheter had already been inserted. In the remainder it was inserted by the collecting doctor. On seven occasions we gave drugs via an umbilical catheter.

Management During Journey

The return journey is accomplished with the emphasis on smoothness rather than speed (though in a few cases the reverse is more appropriate). Even at slow speeds the ambulance gives a fairly bumpy ride unless the road is of motorway standard. This can be a serious problem in an infant being ventilated by hand, as the jolting tends to make the ventilating hand pull on the endotracheal tube. We do not feel that extreme hurry over a journey, sometimes with police escort, and the consequent shortening of journey times is necessarily to the baby's advantage. We emphasize that this applies only to medical cases and that when urgent surgical cases—for example diaphragmatic hernia—are transported the time saved by speed, particularly over longer distances or in heavy traffic, could well be valuable.

Prevention of Hypothermia

Before the journey is started the baby is wrapped in a silver swaddler,⁴ placed in the portable incubator, and well padded with disposable napkins to reduce movement.

In 86 cases the rectal temperature was taken immediately before as well as after the journey (see Chart); 42 (49%) were

Rectal temperatures taken immediately before and after transfer in 86 babies

hypothermic (rectal temperature $<96^{\circ}\text{F}$. (35.5°C .) on initial assessment. The frequent attention required by these sick babies before transfer may explain, in part, the frequency of hypothermia, but cool incubators also played a part. In seven out of nine cases of hypothermia the temperature of the incubator was noted to be 5°F . (2.8°C .) or more below that of the baby. In 44 cases the temperature rose during transfer, in 29 it had fallen, and in 13 it had remained the same. It is evident that a reasonable incubator temperature and adequate wrapping will generally result in a temperature rise even over the relatively short time required for, say, a 7-mile (11-km.) journey. A number of the babies who became colder during the journey needed resuscitation, and so the incubator had to be opened.

Observation

Observation of the baby during the journey is difficult for several reasons. The lighting in the incubator is poor. The silver swaddler impairs the view of the baby, though it is normally carefully folded to leave part of the chest visible. In a moving ambulance it can be very difficult to differentiate respiratory movement from vibration—in a grunting baby the sound of the grunting is usually the most easily detectable sign of respiration. The heart and breath sounds are normally inaudible during the journey unless the ambulance is stopped. Likewise vibration renders palpation of pulses impossible. On a number of occasions we have found an electrocardiographically actuated heart-rate meter to be very useful.

Oxygen and Ventilation

Oxygen is given to all babies except those transferred because of low birth weight or prematurity alone. We have not found it practicable to monitor oxygen concentration during transit. Infants are given enough oxygen to keep them pink. Those requiring ventilation are given intermittent positive-pressure ventilation with 100% oxygen. A Vickers battery-operated ventilator was used in four cases, though on several other occasions it would have been of value had it been taken. A blow-off valve is always used in the circuit when intermittent positive-pressure ventilation is being given. We do not humidify the oxygen given during transfer, as the journeys are of relatively short duration.

Results

The diagnoses at the time of transfer are given in Table II. In most cases there was more than one.

Age, Weight, and Gestation at Transfer.—The gestational age of the babies varied between 26 and 44 weeks with an

TABLE II.—Diagnoses and Mortality Rates in 122 Babies

Diagnosis*	No. of Cases	Percentage of Total	Mortality	
			Rate %	No.
Prematurity	92	75	55.5	51
Respiratory distress	85	70	48	41
Hypothermia	55	45	67	37
Apnoeic attacks	50	41	70	35
Birth asphyxia	39	32	49	19
Intracranial haemorrhage	36	29	97	35
Small for dates	32	26	47	15
Pneumonia	12	10	66	8
Other major infection	12	10	33	4
Congenital heart disease	9	7	44	4
Hypoglycaemia	8	6	75	6

*Prematurity=Gestation period less than 37 weeks from date of last menstrual period.

Respiratory distress=Presence of at least two of the following: (a) expiratory grunting, (b) rib recession, (c) respiratory rate over 60/min.

Small for dates=Birth weight less than 10th percentile, as obtained from smoothed curves, based on National Birthday Trust's Perinatal Mortality Survey,⁵ supplemented by the data of Gruenwald.⁶

Hypoglycaemia=Blood glucose less than 20 mg./100 ml. (whether measured biochemically or by Dextrostix).

Hypothermia=Rectal temperature less than 96°F . (35.5°C).

average of 34. The frequency distribution and mortality are given in Table III. The birth weights varied from 620 to 3,760 g. with an average of 1,900 g. The frequency distribution and mortality rates are given in Table IV. The postnatal age at the time of transfer varied from 30 minutes to 13 days with an average of 18 hours.

TABLE III.—Number of Cases and Mortality by Gestational Age
Gestation in Weeks

	22-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43
No. of cases	4	7	21	22	15	20	13	17	1	2
No. of deaths	4	6	13	10	5	11	2	6	0	1

TABLE IV.—Number of Cases and Mortality by Weight

	Weight in Kg.						
	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-4.5	3.5-4
No. of cases	12	28	32	25	14	7	4
No. of deaths	11	14	16	8	7	1	1

Outcome.—The eventual outcome in the 122 babies was classified in three groups: (1) 52 (43%) were discharged from the intensive care unit apparently completely well; (2) 12 (10%) were discharged with suspicion or evidence of residual disability resulting from the disease present at the time of transfer; and (3) 58 (47%) died.

Effect of Journey on Babies' Condition.—A comparison was made between the babies' "general condition" before and after transit. The general condition was assessed on the result

TABLE V.—Babies Grouped According to Initial Condition and Eventual Outcome

Initial Condition of Babies	Cases		Outcome on Discharge				Died	
			Apparently Well		Suspicion/ Evidence of Residual Disability			
	No.	%	No.	%	No.	%	No.	%
Good	17	14	11	65	2	12	4	23
Intermediate	76	62	39	51	9	11	28	38
Poor	29	24	2	7	1	3.5	26	89.5
Total	122	100	52	43	12	10	58	47

of the initial examination by the collecting doctor at the referring hospital. The condition of the baby was defined as "good" if no abnormal signs or symptoms were present. A previous history of apnoeic attacks did not exclude a baby from this group, provided they were not occurring at the time of assessment. If abnormal signs or symptoms were present the condition was said to be "intermediate" unless the baby was needing artificial ventilation or was in cardiac failure, in which case the condition was classed as "poor." The numbers of babies in each group and their eventual outcome are given in Table V. Of the 17 babies with a good initial condition most were being transferred because of prematurity and/or low birth weight alone. The baby's condition on arrival at the neonatal unit was then compared with that on initial assessment and graded "improved," "unchanged," or "deteriorated." A change in condition was recorded when, on reviewing each case, there was no doubt that there had been a significant alteration in the infant's condition. Such an alteration did not necessarily imply that the infant had moved from one group to another—for example, intermediate to poor. Temperature change has been discussed and was not taken into consideration in assessing condition before and after transfer. Five of the babies improved, 102 remained unchanged, and 15 deteriorated. Of the 15 (12%) babies who deteriorated (Table VI) 4 had a poor initial condition and 11 an intermediate condition. None of the babies whose initial condition was good deteriorated.

TABLE VI.—*Details of 15 Babies whose Condition Deteriorated during Transport*

Case No.	G.A. (Weeks)	Weight (g.)	Main Diagnoses	Nature of Deterioration
1	36	2,400	R.D.S., apnoeic attacks	Progressive deterioration before and after transit. Died later
2	30	1,480	Birth asphyxia, R.D.S., hypothermia, I.V.H.	Progressive deterioration before and after transit. I.P.P.R. already being given before journey. Died later
3	40	2,550	Cyanotic congenital heart disease	Already in heart failure. Continued deterioration. Heart lesion inoperable. Died later
4	28	930	Prematurity, R.D.S., birth asphyxia, hypothermia	Became cyanosed on journey, H.R. fell, O ₂ given by mask. Intubated on arrival. Died later
5	43	3,260	Birth asphyxia, aspiration pneumonia, cyanotic attacks	Became cyanosed on journey, H.R. fell. Intubated on arrival. Survived
6	39	2,760	Respiratory distress, apnoeic attacks	Respiration became inadequate, H.R. fell. Intubated on arrival. Died later
7	35	2,200	Prematurity, apnoeic attacks	Became cyanosed on journey despite continuous I.P.P.R. Died later
8	33	963	Prematurity, R.D.S., I.V.H.	First apnoeic attack in ambulance, intubated in ambulance. Died later
9	35-40	3,040	R.D.S., apnoeic attacks	Apnoeic attack in ambulance, intubated. Survived
10	30	2,550	Mother diabetic. Premature, R.D.S., I.V.H.	First apnoeic attack in ambulance, intubated. Died later
11	34	1,596	Premature, R.D.S.	First apnoeic attack in ambulance. Responded to stimulation. Survived
12	35	1,710	Premature, R.D.S., apnoeic attacks	Apnoeic attacks worsened while in transit. E.T. already in position. Survived
13	37	1,926	R.D.S., apnoeic attacks	Major pulmonary haemorrhage. Died in ambulance
14	39	2,920	Birth asphyxia, apnoeic attacks, I.V.H.	Oral E.T. dislodged. Died soon after arrival
15	36	2,060	Prematurity, apnoeic attacks	Became cyanosed when oxygen cylinder ran out. Needed I.P.P.R. Survived

I.V.H.—Intraventricular haemorrhage. R.D.S.—Respiratory distress syndrome. I.P.P.R.—Intermittent positive pressure ventilation. H.R.—Heart rate. G.A.—Gestational age. E.T.—Endotracheal tube.

Discussion

Two kinds of neonatal nursery are probably needed to provide the best care for all newborn babies. The great majority can be looked after in a nursery providing primarily good nursing care. A small minority of babies, many of whom are premature, have serious illnesses which require intensive care, and this demands a large staff of paediatricians and nurses. The fact that an infant will need such care cannot always be anticipated, but when it can there is a strong case for delivery in a unit where specialized obstetric and neonatal facilities are available. Failing this it must be accepted that, while it is a serious matter to part a mother and her child, treatment of acute illness must take priority over emotional considerations and the child must be transferred to an intensive care unit.

It is often difficult to decide when to transfer a baby, especially one with an illness such as hyaline membrane disease which may resolve spontaneously. The reason for transfer in all cases was a lack of facilities or staff to deal with the problems that the baby presented. Early transfer of a mildly ill baby is preferable to the transfer of a baby whose condition has deteriorated to a state where there is little hope of recovery. Most infants were transferred early, but in many cases transfer was left till late in the illness. Though it is extremely difficult to judge retrospectively, we felt that one-third of the babies whose initial condition was poor might have benefited from earlier transfer.

Babies no longer needing the specialized care of the neonatal unit, but not ready to go home, may be returned to the referring hospital.

Technical Problems of Transport

The difficulties in observing and treating a baby in a moving ambulance make it impossible to follow exactly the same rules in management as are considered appropriate in the

neonatal ward. The procedure we have described has been evolved by successive neonatal resident staff over the past three years, and is a compromise between what would be ideal and what is practicable. The decisions to carry out prophylactic intubation in infants who are at risk from apnoeic attacks and not to monitor oxygen therapy are examples of such a compromise. Neither would be acceptable as part of normal care in the neonatal ward.

We attach particular importance to the prevention of hypothermia, for keeping babies warm is one aspect of neonatal care which has been shown to reduce mortality.^{7,8,9} In general the methods used for keeping the babies warm during transit seem to have been successful, and it is satisfactory that most of the hypothermic babies had a rise in body temperature during the journey. It was, however, unfortunate that 49% were hypothermic before starting the journey, and we feel that it would be helpful if greater attention were paid to keeping babies warm before their transfer. An incubator temperature of 85°F. (29.4°C.) is often regarded as adequate irrespective of the baby's gestation or body temperature, but small babies may need an incubator temperature of 94°F. (34.4°C.).¹⁰

It is obviously impracticable for specially equipped ambulances to be available for the transfer of every sick neonate, though one would be especially useful for long journeys. Two special ambulances have been described for the transport of sick infants,^{11,12} both equipped to facilitate observation and resuscitation of the infant in transit.

How Well do Babies Travel?

The condition of 5 babies improved and that of 102 did not change significantly during the journey. Only 15 became worse (Table VI). Some would certainly have deteriorated whether or not they had been moved. There is little to suggest that travel per se harmed any of the babies, but if observation during the journey had been easier the deterioration in some of those who became worse during transport might have been noticed and treated earlier.

It must be remembered that the babies reviewed were a highly selected group, and all must have given rise to anxiety in their clinicians for them to have been transferred in the first place. Indeed a large proportion of those whose initial condition was poor were frankly moribund. These facts must be taken into account when the rather unsatisfactory overall mortality figures are considered.

Conclusion

It appears that provided adequate precautions are taken there should be little added risk in transporting sick infants by ambulance over short distances. This risk must be balanced against the improved facilities the specialized hospital has over the referring centre. The precautions we recommend are:

(1) Assessment of the infant by a physician used to dealing with neonatal problems should precede transfer. The question must then be asked, "Is it safe to transfer this baby without a doctor in attendance?" The fact that tracheal intubation was deemed necessary in 40% of the infants reviewed gives some indication of how ill these babies were and how important was the presence of a doctor during the journey. We believe that in the majority of cases a doctor should accompany the baby, as problems may arise which are beyond the province of a nurse.

(2) The infant should always be transported in an incubator.

(3) Babies should be warmly wrapped and padded to prevent excessive movement within the incubator.

(4) "Prophylactic" intubation should be considered in any baby who has respiratory distress or a history of apnoeic attacks. It is essential if either of the conditions is even moderately severe.

(5) A nasotracheal tube should be used where possible, and the stomach contents should be aspirated before intubation.

(6) Hypoglycaemia and acidosis should be treated before starting the journey.

(7) The use of a heart-rate monitor should be considered in all infants whose initial condition is less than good.

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ANY QUESTIONS?

We publish below a selection of questions and answers of general interest.

Antacids and P.A.S. Absorption

Q.—It used to be said that aluminium hydroxide was the best antacid to use for gastritis caused by P.A.S., since it did not interfere with absorption as much as other antacids. Is there any further knowledge about antacids in the absorption of P.A.S.?

A.—Antacids are sometimes effective in relieving the troublesome gastrointestinal effects of P.A.S., and are widely recommended for this purpose.¹ However, one investigation² suggested that antacid agents interfered with P.A.S. absorption and reduced blood levels. Another study failed to show impairment of absorption of P.A.S. as a result of the concurrent administration of magnesium trisilicate and aluminium hydroxide gel.³

These conflicting results leave doubt about the effect of antacids on P.A.S. absorption. It is, therefore, desirable to overcome side effects if possible by changing the P.A.S. preparation—i.e., to granules or cachets rather than by the use of antacids.

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Gammaglobulin in Rubella

Q.—Is it proved that gammaglobulin as a prophylactic against rubella in early pregnancy diminishes the number of fetal abnormalities?

A.—The proposition that giving gammaglobulin in these circumstances prevents fetal abnormalities is very difficult to prove. McDonald and Peckham¹ essayed an answer. Their study was confined to the period 1956–62, when 35,825 doses of gammaglobulin were issued to doctors, the dose varying between 750 mg. and 1,500 mg. The outcome in 88% of these women exposed to rubella in pregnancy was determined shortly after confinement and a sample was investigated when the children were 2 or more years of age.

Of those given the gammaglobulin whose contact with the disease arose within the family, 1.95% developed clinical signs of rubella, while 0.48% whose contact with the disease was outside the family did so. From other evidence it was thought that the attack rate for clinical rubella was diminished as a result of treatment. When those women who had been in contact with rubella in pregnancy were compared with those who had had gammaglobulin after contact with the disease, it was found that therapy had probably reduced stillbirths from 1.7% to 1.3% and congenital defects from 2.9% to 2.4%. Those who had had definite clinical rubella in the first 12 weeks of pregnancy produced about one-quarter of their children with some abnormality. A cautious reply, therefore, is that gammaglobulin probably does reduce the incidence of congenital defects in those mothers who have been exposed to rubella in early pregnancy, but it is not an effect which can be fully relied on. Indeed, it cannot be expected fully to prevent even the clinical signs of the disease.

The investigation reported was done before virological tests for infection were often made. Now virological testing can help in deciding whether a contact of the disease has recently had an infection by the virus, with the risks for the fetus that this entails.² Probably the best management of a patient who has been a contact of a rubella case or who has had a fleeting rash during pregnancy is to enlist the aid of a virological laboratory immediately. From antibody studies the virologist can often state whether the patient has been infected. If he can state this with reasonable assurance, then the pregnancy should be terminated, for a risk of the baby being abnormal in one-quarter of cases—the risk being about 50% in the first month and about 12% in the third—is more than the average woman of today ought to be asked to take. If the virologist leaves the clinician in doubt then the decision whether or not to terminate must depend on the clinical likelihood of infection and on the psychological state of the patient, together with consideration of her age and previous fertility as well as social factors. This would seem to offer a

better chance of the prevention of fetal abnormality than reliance on gammaglobulin, though this should be given to those who carry on with their pregnancies. Soon it is hoped that there will be a vaccine developed in sufficient quantity that those at risk may be actively immunized without danger to themselves.³ With the millennium this ought to ensure that gammaglobulin and termination of pregnancy will be unnecessary as methods for preventing fetal abnormality.

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* * * The Department of Health is now providing rubella virus vaccine for girls aged 11–14 (*B.M.J.*, 1 August, p. 292).—Ed. *B.M.J.*

Pes Cavus

Q.—What is thought to be the aetiology of pes cavus? What is the balance of opinion on whether it is congenital or acquired, and do some experts still feel that pes cavus is frequently induced by overaction of the intrinsic muscles of the sole?

A.—Pes cavus is commonly seen in various neurological diseases, probably the commonest being Charcot-Marie-Tooth and Friedreich's ataxia. It is also seen in spina bifida occasionally, and used to be seen in poliomyelitis. Finally, there is probably an idiopathic pes cavus, though as cases of this are more fully investigated they diminish in number, since a paralytic explanation is available.

Pes cavus is almost certainly, in the diseases mentioned, the result of muscle imbalance. There is rather a paralysis of the intrinsic or weakness of them with unopposed action, particularly of the tibialis anterior pulling the dorsum of the foot to an apex. However, the explanation in terms of muscle imbalance of pes cavus is not simple and certainly not proven. It certainly exists in diseases where intrinsic muscular weakness is present from an early age, and it is believed to be related to this.