frequent pregnancies have begun to undermine the system, the cases, namely, in which experience has taught us that any subsequent gestation may aggravate the danger to the woman's constitution and render her an ailing mother ill equipped for her manifold duties. For all such cases, as for those with grave medical disease in whom sterilization is refused or is unprocurable, birth control should be recommended on the understanding that in the event of pregnancy occurring it may require to be terminated prematurely if the health of the mother renders this necessary.

Within recent years the Ministry of Health has acknowledged its responsibility towards women in attendance at maternity and welfare clinics who require such advice, and in 1930 it empowered local authorities to make provision for contraceptive information being given to married women for whom future pregnancy would be detrimental to health. A large number of authorities have availed themselves of this power, and have arranged for the instruction to be given at special sessions held at the maternity and child welfare centres, by contract with a neighbouring voluntary clinic, or in some other way. There are obvious advantages in linking up the birth control service with the maternity and welfare centres. In that this service is essentially preventive it comes naturally within the functions of the centre, and it is convenient both for the woman and her advisers that she should receive this class of treatment at a place where she is known and where her medical state has already been under observation. At the same time it is important that the instruction should be given by an officer who is specially trained and who attends at the

centre at a session convened for the purpose. A further matter of considerable moment, and this applies to all classes of birth control clinic, is that there should be, as an integral part of the service, an arrangement by which women suffering from serious disease which renders pregnancy dangerous can be referred for sterilization to a neighbouring hospital or some other suitable agency.

CONCLUSIONS

1. The birth control movement is creating important problems in public health which demand the urgent participation and guidance of the medical profession.
2. Whilst the duty of the doctor is clear in regard to women suffering from disease which renders pregnancy dangerous, the profession cannot evade the important responsibilities in public health implied in birth control employed for social and economic reasons.
3. There is need for the teaching of medical students and doctors in the methods of birth control.
4. On the medical problems inherent in the movement there is urgent need for further research.

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PREVENTION OF MEASLES BY CONVALESCENT SERUM*

BY

THOMAS M. HUNTER, M.B., CH.B., D.P.H.

SENIOR ASSISTANT PHYSICIAN, KNIGHTSWOOD FEVER HOSPITAL, PUBLIC
HEALTH DEPARTMENT, GLASGOW

During the winter of 1931-2, when there was an epidemic of measles in Glasgow, I undertook an investigation into the effect of administering convalescent serum to measles contacts in hospital wards and children's institutions. The prevention of measles by serum is an important subject, but one which presents considerable administrative difficulties in its general application. Though the reports of the results of serum injections are promising, the exact manner in which the limited amount of serum available should be used to obtain the maximum effect forms a distinct problem. What can be accomplished with convalescent serum? What are its keeping properties? What doses would be most useful during epidemic periods? These are the main points which should be determined.

For the purposes of this investigation the following material was available, obtained from adult convalescent patients:

Number of donors ...	54	
Amount of blood ...	5,108 c.cm.	Average 94.6 c.cm.
Amount of serum ...	2,960 c.cm.	Average 54.8 c.cm.
Number of doses (5 c.cm.)...	584	Average 10.8

Donors did not become available until November, when the epidemic was well advanced. The serum was collected under aseptic precautions on the seventh to tenth day of normal temperature, and, after the addition of a small amount of trikresol, was stored in an ice-chest. The dose adopted as a standard was 5 c.cm. injected intramuscularly. Temperatures were taken four-hourly from the eighth day of exposure, and the observation period extended till the twenty-third day of exposure, a length of time likely to exclude a normal attack, but in a few cases insufficient to allow for an attenuated attack. In

most of the cases, however, this time was quite sufficient to give returns of service. Most of the factors governing the result of injection, such as type of attack of donor, age of serum, day of exposure, etc., were noted, but the evaluation of each is difficult since, even when all other factors are exactly similar, varying results tend to occur. Despite these variations, however, there are some interesting facts to be noted.

DEFINITIONS

The results were classified into (a) complete protection, (b) attenuated attack, (c) mild, and (d) normal attacks. "Attenuated" attacks showed no Koplik's spots and no fever (except perhaps a transient rise of temperature on four-hourly readings, with little or no catarrhal symptoms). The rash was more like discrete pin-points, more papular than, and certainly never typical of, a measles exanthem. It appeared on the face, occasionally including the body, and seldom the limbs. A "mild" attack was a little more definite than an attenuated one, but less so than a normal attack, there being some cough generally and somewhat more fever, with eye suffusion, etc. The "normal" case had the classical signs and symptoms. These three types were further subdivided as regards the case from which the patient was presumably infected. "Primary" cases were those which developed infection after the original exposure; "secondary," those after one of these primaries or a coincident control; and "tertiary" cases, those which developed measles from a totally different source, perhaps weeks later.

THE INQUIRY REPORTED

The scope of this investigation comprises fifty instances of exposure, involving 345 patients. One group of eighty-nine in a mental home has been excluded owing to the possibility of error in the history of previous attack, but the other forty-nine groups can be considered, as far as possible, free of error in this respect, as great care was taken in extracting histories. For instance, there were only eleven that were given serum who had had a previous attack of measles—cases mostly about whom information was not available at the time of injection. Again, out

* Communication to the Section of Public Health at the Centenary Meeting of the British Medical Association, London, July, 1932.

of the remaining 245 cases there were twelve who died in the observation period, and who are, therefore, disregarded. Since there were many other diseases affecting these children, who for the most part were in-patients in institutions, it is fortunate that there were so few who succumbed to the other disease during the period. There thus remained 233 patients inoculated with convalescent

TABLE I.—*Details of Cases*

Total number of contact cases injected	...	...	...	...	345
Doubtful negative history of measles	...	...	...	...	89
Known positive history of measles	...	...	...	...	11
Negatives who died in observation period	...	...	...	...	12
					112
Total of definitely known susceptibles	...	...	...	...	233
Result of injection:					
(a) No attack	...	...	...	...	185
(b) Attenuated attacks—Primary	...	...	...	...	28
Secondary	...	...	...	...	6
Tertiary	...	...	...	...	2
(c) Mild attacks—Primary	...	...	...	...	7
Secondary	...	...	...	...	1
(d) Normal attacks	...	...	...	...	4
Control cases—No attack	...	...	...	...	9
Measles	...	...	...	...	23
					32

serum, and of these 185 entirely escaped infection—equivalent to a protection rate of 80 per cent. In thirty-six cases the attack was attenuated. It may be observed that twenty-eight of these contracted the infection from the original case of measles, six from a subsequent or "primary" case, or a coincident "normal" case, while two were later reported to have developed measles beyond that period. There were very few "mild" cases—eight in all—and of these seven were primary and one secondary. Of these, four out of the seven had only 1.7 c.cm. instead of the usual 5 c.cm., so that the number is even less than that given if the standard dose is considered. Four patients developed normal measles after serum, but as these showed rashes one, two, three, and five days respectively after the injection it is apparent that the dose was given much too late to have any preventive effect. As controls there were thirty-two cases who did not receive an injection of serum, and of these no fewer than twenty-three contracted measles. Table I shows these results.

The several factors—day of injection of serum, its age and dosage, age of the child, and the value of the serum from different donors—may be considered separately.

TABLE II.—*Day of Exposure to Measles*

Day	Total Contacts	No Attack	Primary		Measles	Per cent. Protected	Per cent. Average of Three Days
			Att.	Mild			
1	—	—	—	—	—	—	—
2	4	4	—	—	—	100	—
3	6	6	—	—	—	100	86.15
4	55	46	9	—	—	83.63	85.8
5	52	45	7	—	—	86.54	82.6
6	48	37	7	4	—	77.08	82.9
7	29	25	2	2	—	86.21	81.5
8	15	13	2	—	—	86.65	83.4
9	4	3	1	—	—	75	84
10	6	5	—	1	—	83.34	80
11	—	—	—	—	—	—	75
12	2	1	—	—	1	50	50
13	—	—	—	—	—	—	—
14	1	—	—	—	1	0	0
15	1	—	—	—	1	0	0
16	1	—	—	—	1	0	0
6-9	9	9	—	—	—	100	—
Total:	233	194	28	7	4	83.26	—

1. *Day of Injection.*—The average day of exposure on which the rash appeared in the control cases was shown to be 17.4 days. The four cases of normal attacks, therefore, must have been injected not on the third and fourth days, but on the twelfth, fourteenth, fifteenth, and sixteenth days. Correction must, of course, be made for the second exposure of a case, since, if this second exposure did not occur, the contact would have remained protected. Again, in order to compensate for slight variations in estimating the day of exposure, an average of three days is probably more accurate than the single figure of the day concerned. Table II is constructed on this principle. Thus, presuming that the other factors are constant, there is evidently no marked change in the efficacy of the injections given up to the eighth day after exposure—that is, taking the day of the rash as the fourth day. The numbers protected on the ninth and tenth days are rather small on which to base such a claim for them. Immediately after the tenth day, however, there is a very rapid falling off in the potency, and by the fourteenth day there is no protection whatever. These figures indicate fairly clearly that even a small dose of 5 c.cm. is of value in the prophylaxis of measles.

2. *Age of the Serum Used.*—Table III gives the results according to the age of the serum employed. Correction must also be made here for deaths and secondary cases.

TABLE III.—*Effect of Age of Serum*

Age in Days	Total Cases	No Attack	Primary		Measles	Per cent. Protected	Per cent. Average of Three Groups
			Att.	Mild			
-25	11	11	—	—	—	100	—
-30	29	23	1	1	1	89.6	83.9
-35	47	36	7	4	—	76.6	81.5
-40	32	26	6	—	—	81.2	79.6
-45	9	8	—	—	1	88.9	81.8
-50	5	5	—	—	—	100	77.3
-55	8	4	4	—	—	50	65.2
-60	10	6	2	—	2	60	59.1
-65	4	3	1	—	—	75	52.2
-70	4	4	—	—	—	100	76.9
-75	5	3	2	—	—	60	88.2
-80	8	8	—	—	—	100	93.5
-85	8	8	—	—	—	100	91.3
-90	19	17	2	—	—	89.5	92.5
-95	13	12	1	—	—	92.3	86.6
-100	13	10	2	1	—	76.9	85.6
-110	4	4	—	—	—	100	81.2
-120	2	2	—	—	—	100	100
-130	—	—	—	—	—	—	75
-140	2	1	—	1	—	50	—
Total:	233	194	28	7	4	83.26	—

The table shows that within the limits covered—that is, using serum up to 140 days old—there is practically no difference in the results attributable to the age of the serum.

3. *Age of Injected Child.*—Here again the same corrections are made, the primary cases of the disease alone being entered in the table (Table IV). The results here indicate that there seems to be some relation between the effect produced and the age of the child. In the first year protection, complete at first, falls, and in the middle of the second year is relatively low, remaining so till the beginning of the fourth year, after which the results

improve. These figures indicate that the danger period is the second year, the third year, and the first half of the fourth year of life, the figures for these periods being under the general average of the complete series. These results are in keeping with the known epidemiological

TABLE IV.—*Effect of Age of Patient Injected*

Age of Patients	Total Cases	No Attack	Per cent. Protected	Per cent. Average of Three Groups
Months 0-2	—	—	—	—
3-5	29	38	97.43	—
6-8	19	18	94.74	94.74
9-11	13	16	88.89	85.45
One year 0-2	13	13	72.22	80.85
3-5	11	9	81.82	69.56
6-8	17	10	58.82	73.53
9-11	6	6	100	72.73
Two years 0-2	21	16	76.19	75
3-5	5	2	40	75.68
6-8	11	10	90.91	75
9-11	4	3	75	76.92
Three years 0-2	11	7	63.63	72.22
3-5	3	3	100	68.75
6-8	2	1	50	83.33
9-11	1	1	100	90.91
Four years 0-2	8	8	100	100
3-5	—	—	—	100
6-8	6	6	100	100
9-11	1	1	100	—
Total	201	168	83.58	—

facts that the first five years of life are those most susceptible. The figures make it clear that the effect of serum injection closely follows the same curve.

4. *Donors of Serum.*—Again it is difficult to evaluate the serum, as the other factors exert some influence on the result. Comparison of the tables compiled during the investigation show that, while as a whole the serums of the donors were fairly potent, there were undoubtedly some poor ones. For instance, in one case of cross-infection twelve contact patients were injected, and only three remained free from attack. The serum used was from the same donor injected in varying doses, but the effect produced was poor in comparison with that obtained under less favourable circumstances with another serum. Possibly, had another donor been chosen the results would have been more favourable, as the records indicated that this particular donor had had a less severe measles attack than the average.

5. *Amount of Serum Injected.*—Little can be said on the practical side, since the dose given in this series (5 c.cm.) was practically constant. In one instance, however, varying doses were given on the sixth day, and it was found that while 3.4 c.cm. gave either no attack or attenuation, a dose of 1.7 c.cm. gave resulting mild attacks.

6. *Duration of Immunity.*—The duration of the immunity produced by the serum varied in many of the cases; it probably varies with the amount injected. In my series, using the standard dose of 5 c.cm., modified cases occurred after the usual incubation period, indicating that the protection afforded was not always complete. The number of secondaries is probably larger than that

recorded, but judging from the figures available in my series the number is greatest in those injected in the first six days of exposure. This seems to suggest that the period of complete protection given by 5 c.cm. is not much longer than fourteen days, but, as can be seen from the "tertiary" infections, it may extend up to six weeks, and even then the protective power is still sufficient to modify the attack.

GENERAL CONCLUSIONS

Clinically there was a striking difference in the type of attack after such a small dose as 5 c.cm., even up to the eighth or tenth day of exposure. Of all the patients who developed measles after serum not one was really ill, and, in fact, many would not have been reported had not the slightest appearance of any sign been noted as evidence of infection. Generally speaking, it would appear that the best method of utilizing the serum is not to prevent measles by large doses, but rather to cause what might be a fatal attack to be an attenuated one with no complications. The active immunity thus produced will be invaluable, whereas the passive immunity lasts only two to six weeks in the complete state.

Summarizing the results obtained, there is no doubt that the injections were of great benefit, as they secured complete protection in almost 80 per cent. That this did not always result suggests that if such is the object a sufficient dosage should be employed on an early day after exposure. The useful period for complete protection in my series appears to be slightly greater than other investigators have found, but it must be remembered that the suspicion of measles was sufficient to mean the immediate removal of a possible source of contagion from children's wards, resulting in a comparatively short period of exposure. Administratively, the procedure of protective inoculation of convalescent serum was of great value in controlling possible outbreaks of measles in hospitals and country homes devoted to the treatment of young children.

ISOLATED DEXTROCARDIA

BY

T. H. G. SHORE, M.D., F.R.C.P.

PHYSICIAN TO THE SOUTH DEVON AND EAST CORNWALL HOSPITAL,
PLYMOUTH

Although reports on a considerable number of cases of isolated dextrocardia have been published, the condition is sufficiently rare to justify recording another case.

Dextrocardia naturally accompanies complete transposition of the viscera, which is not a very uncommon condition. All the organs are then transposed to the opposite side of the body, and at the same time their individual forms are transposed, the result being a mirror-image of the normal. I have seen several examples of this condition during life and one post mortem. Rarely, such a transposition is incomplete so that one organ or more escapes; a few instances have been recorded of transposition of all the organs except the heart. In the following case the heart only was transposed to the right side.

If displacements resulting from disease are excluded, true dextrocardia is a developmental error. According to Lichtman,¹ who has made a most careful review of the subject, most of the recorded cases have died in the first year of life; if the patient lives to the age of 10 the expectation of life is 30 years, after 20 the expectation is 44 years. Few, however, are so fortunate.

The subject when studied in detail is much more complicated than would at first appear. Dextrocardia, as it occurs with complete transposition—a mirror-image both