challenge. The rabbit and cynomolgus-monkey interferons were also effective when given simultaneously with the vaccinia virus.

The third experiment showed that chick, rhesus, cynomolgus, human-amnion, and rabbit interferons were all active in suppressing the lesions when given 24 hours before challenge (Table III). Necrosis was observed only in the vaccinia controls. When the interferons were given at the same time as the challenge the homologous interferon gave good and the cynomolgus interferon slight protection.

Observations on the development and subsequent remission of the lesions confirmed these findings.

The results of the single experiment with a cynomolgus monkey are shown in Table IV, and also in Fig. 2, where it will be seen that the homologous interferon and the heterologous chick interferon (G 5) were highly effective in inhibiting vaccinial lesions. The rhesus-monkey interferon was rather less active.

Attention is called to the fact that the chick interferon (G 5) was found to be minimally active in rabbits (Table II) and that the rabbit (G 12) and the chick interferons (G 29C) were active in rabbits but inactive in the cynomolgus monkey.

Discussion

Isaacs and Westwood (1959) have described the superiority of rabbit over chick interferon in the inhibition of vaccinial lesions in the rabbit skin. Sutton and Tyrrell (1961) have shown in tissue-culture systems that interferon prepared in homologous cells is more effective than that prepared in heterologous cells. They also found that this species specificity in the action of interferon was not absolute, and, in particular, that rhesus-monkey interferon was the one most active on heterologous cells, including human cells. The work described here confirms these observations to some extent. Thus the rabbit and monkey (cynomolgus) interferons were most active in rabbits and a monkey, respectively. However, significant inhibition of vaccinial lesions in the skin was produced by some preparations of heterologous interferon. This observation could be important if interferon proves effective in human virus infections and might open the way to use of non-human cells in preparing interferon intended for therapy in human subjects. At present the evidence adduced here, like that of Sutton and Tyrrell (1961), suggests that monkey cells are a source of interferon that could reasonably be used in experimental work on man, but the choice of the best cell for producing interferon for use in man must await the results of further tests and clinical trials.

Summary

Interferon prepared from various species of cells has been found to inhibit the development of vaccinial lesions in the skins of rabbits and a monkey. Though the interferon prepared in homologous species of cells has the greatest effects, significant inhibition was produced by some interferons prepared from heterologous cells.

I thank Dr. J. A. Dudgeon for his advice and encouragement, and Mr. G. T. Hawkins and Mrs. E. M. Kemp for their able technical assistance. The sample of chick interferon supplied by Dr. A. Isaacs, of the National Institute for Medical Research, and one of calf interferon supplied by Dr. N. Finter, of Imperial Chemical Industries, are gratefully acknowledged.

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EPIDEMIOLOGY OF ACUTE INTUSSUSCEPTION

BY

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The north-east region of Scotland is a very suitable area in which to carry out incidence studies. About 90% of all the surgical emergencies occurring in the population of 425,000 are dealt with in the Aberdeen general and special hospitals. When the fringe counties of Kincardineshire and Morayshire are excluded the percentage of referrals approaches 100%. This is especially true of an acute abdominal condition such as intussusception. Several detailed studies on the incidence of intussusception have been carried out in densely populated and industrial areas of Britain (Morrison and Court, 1948; MacMahon, 1955; Court and Knox, 1959; Smith, 1960), but little has been known about its incidence in a less densely populated and mainly rural area. The present investigation was designed to provide such information.

The Investigation

Clinical Material.—The case records of all acute intussusceptions occurring in Aberdeen City, Aberdeenshire, and Banffshire during the years 1950–9 were studied. There were 145 cases, 140 being of the so-called idiopathic type. All except three had been treated at the Royal Aberdeen Hospital for Sick Children; smaller peripheral hospitals were visited to ensure that no cases were missed. From the data collected the incidence in the population at risk, the seasonal incidence, the age-and-sex distribution, and the family histories of the children affected were determined.

Incidence

During the decade under review there were 66,144 live births in the three areas designated above. The 145 intussusceptions occurring during this period therefore give an overall incidence of 2.19 per 1,000 live births (Table I). When the incidences in the city and in the two county areas are compared, it is found that the incidence is greater in the rural districts (2.55 per 1,000 births compared with 1.81 in the city). This difference is statistically significant ($\chi^2=4,131$; D.F. 1; $0.02<P<0.05$). The permanent address of the mother has been

used in classifying the live births; this eliminates the possibility of maternal migration to the city at full term giving an excessive number of births within the city and so an artificially low incidence of intussusception. Comparable figures for other cities are given in Table II.

TABLE I.—*Incidence per 1,000 Live Births in City and Rural Areas of N.E. Scotland*

	Cases	Live Births	Incidence per 1,000 Live Births
Aberdeen	58	32,033	1·81
Aberdeenshire	68	25,484	2·66
Banffshire	19	8,627	2·20
	145	66,144	2·19

TABLE II.—*Incidence per 1,000 Live Births in British Cities*

Newcastle	4·3	Edinburgh	1·57
Birmingham	1·49	Aberdeen	1·81

Seasonal Incidence.—It has often been suggested that intussusceptions may be more common at certain times than at others. In the present series both the numbers of cases occurring in each of the months of the year (monthly incidence, Fig. 1) and the number of months with different numbers of cases ("run" analysis, Fig. 2) have been calculated for the 10-year period. The monthly incidence shows that intussusception occurs slightly more often in spring and autumn, but the difference between the various months is not great, ranging from 7 to 18. The run analysis, to see if intussusception took place in small epidemics, was inconclusive, there being little systematic disagreement between the observed data and the theoretical Poisson distribution. When, to test for clumping of cases, the observed variability is compared with the value expected if the cases occurred at random, the difference is not significant ($\chi^2=123$; D.F.$=119$; $P>0.1$) when periods of one month are studied—that is, there is no evidence of clumping in months. There is, however, some indication of grouping of cases over periods of a few months, particularly in 1954 and 1955. A test of the heterogeneity of the number of cases occurring in each of the 20 six-month periods reviewed gave a χ^2 of 30.4 (D.F.$=19$; $0.02<P<0.05$). For the 10 twelve-month periods $\chi^2=18$ (D.F.$=9$; $0.02<P<0.05$). There is therefore some evidence of non-randomness in the occurrence of intussusception over longer periods.

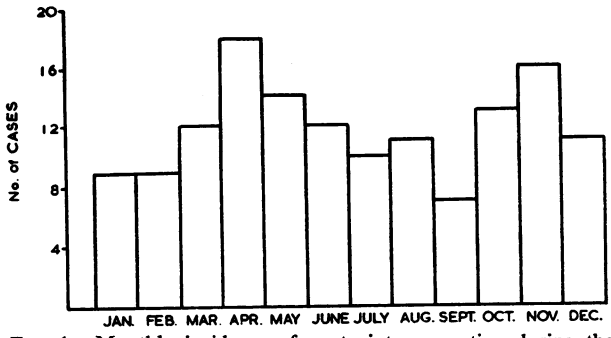

FIG. 1.—Monthly incidence of acute intussusception during the 10-year period 1950–9.

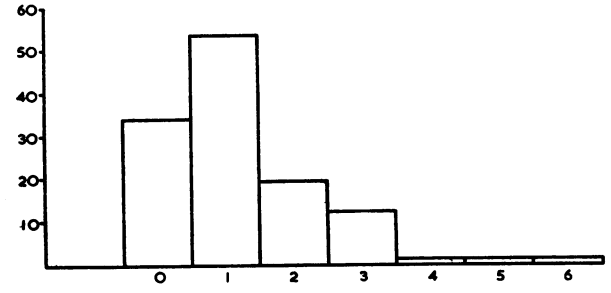

FIG. 2.—Monthly "run" analysis, showing the number of months (ordinate) in which various numbers of cases of intussusception (abscissa) were admitted. Average per month = 1.2.

Age and Sex Distribution

In recording the age of the children affected the actual age at the time of admission has been used, not the age next birthday. All the children are aged 6 years or under, apart from one boy of 11 years (Fig. 3). Only 77 patients, representing 53% of the total, are less than 1 year of age, which is a much smaller percentage than that given by other authors (Table III).

In this series of 145 patients, 60% are males—a male preponderance rather lower than that usually found (Table IV). In infants under the age of 9 months MacMahon (1955) found no sex difference, but in the present series there is still a slight male preponderance, 55%.

In females 56% of intussusceptions occur before the age of 1 year, while in males 50% are below that age. Wilcoxon's test (Siegel, 1956) was applied to assess the significance of the sex differential in the male and female groups. The calculated probability of the differential occurring by chance is less than 1 in 100; the earlier onset of intussusception in girls as compared with boys is therefore highly significant and may indicate a difference in the inherited susceptibility to the condition in the two sexes. In the rural areas 63% of the patients were males, while from the city only 55% were males.

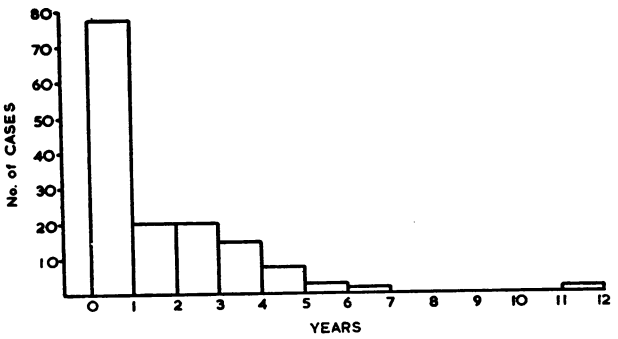

FIG. 3.—Age distribution in 145 cases of acute intussusception.

TABLE III.—*Percentage of Patients Below 1 Year of Age in Six British Cities*

Author	Area	Below 1 Year
Kyle (1954)	Belfast	71%
Perrin and Lindsay (1921)	London	70%
Stewart (1960)	Edinburgh	69%
MacMahon (1955)	Birmingham	65%
Strang (1959)	Glasgow	63%
Present series	Aberdeen	53%

TABLE IV.—*Sex Ratio in Ten Different Areas*

Author	Area	Percentage Male
Stewart (1960)	Edinburgh	69
Fitzwilliam (1908)	U.K.	68
Koch and Oerum (1912)	Denmark	68
Kyle (1954)	Belfast	66
MacMahon (1955)	Birmingham	65
Hipsley (1926)	Australia	64
Strang (1959)	Glasgow	63
Clark *et al.* (1959)	Canada	60
Present series	Aberdeen	60
Morrison and Court (1948)	Newcastle	55

Family History

In this series of 145 cases there are two families (one out of 72 families) in which another sibling or parent has had an intussusception. MacMahon (1955) calculated that the eight affected families in his series of 396 cases (one out of 50) represented a familial incidence 40 times greater than would have been expected by chance. Although less marked, the familial incidence in the present series still is much greater than can be accounted for by a random occurrence of intussusception, and the figure has been derived simply from a review of case records. Detailed field inquiries, as carried out by MacMahon, might well reveal more affected families. In one of the two families noted the father, a general practitioner, had suffered from a recurrence of his intussusception, and a similar double misfortune befell his son.

Discussion

The incidence of acute intussusception in the City of Aberdeen (1.81 per 1,000 live births) is only slightly greater than that in Birmingham and Edinburgh. The accuracy of ascertainment of cases is probably the same in all three regions and in Newcastle, since the reported incidence of congenital pyloric stenosis (approximately 3 per 1,000 live births) is the same in each of them (Davison, 1946 ; MacMahon *et al.*, 1951 ; McLean, 1956 ; Smith, 1960). The significantly greater incidence in the rural areas is unexplained, but it is still little more than half the Newcastle figure.

Intussusception may result from a congenital predisposition being triggered off by an acquired agent. The male preponderance and the increased incidence of intussusception among relatives may be accounted for by some inherited predisposition or abnormality such as excessive quantity or reactivity of alimentary lymphoid tissue. It is difficult to account for them by any other theory. At the same time an acquired agent seems the most likely explanation for intussusception occurring in small outbreaks lasting a few months. The nature of the acquired agent is unknown, and it may not be pathogenic in ordinary infants. The unusually large size of the mesenteric lymph nodes suggests that they may react vigorously. No known bacterium has been found blameworthy ; information is being collected about adenoviruses to determine whether or not they play any part in the aetiology of intussusception.

The increased incidence in the rural areas is not fully explained by either part of this suggested dual aetiology. Inbreedings could increase a congenital predisposition. On the other hand, failure of the infant to become immunized either passively or actively at a very early stage of its development to a relatively innocuous external agent such as an adenovirus may render it more susceptible to that agent at the age of a few months.

Summary

The incidence of acute intussusception and the age-and-sex distribution and family histories of the 145 patients seen in North-east Scotland from 1950 to 1959 have been determined.

The overall incidence is 2.19 per 1,000 live births ; the incidence is significantly greater in the rural area than in the City of Aberdeen.

The male preponderance is less marked than in other regions, but the sex differential is still highly significant.

When analysed for periods of six and twelve months, intussusception occurs in a non-random manner.

These findings suggest that acute intussusception results from a congenital predisposition being triggered off by an acquired agent, possibly an adenovirus.

We thank the medical staff of the Royal Aberdeen Hospital for Sick Children for permission to carry out this study, and Professor E. M. Backett and Dr. R. D. Weir, of the Department of Social Medicine, University of Aberdeen, for their advice. We are indebted to Dr. W. Brass, of the Department of Statistics, for his help in performing the statistical analyses.

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TWO INCIDENTS OF TUBERCULOUS INFECTION BY MILK FROM ATTESTED HERDS

PUBLIC HEALTH AND CLINICAL ASPECTS

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This report describes two recent incidents where tuberculous infection occurring in children was apparently related to the consumption of milk from attested herds.

First Incident

In July, 1959, a routine tuberculin test of an attested dairy herd in Oxfordshire revealed six reactor cows. These animals were removed and slaughtered, and on post-mortem examination one animal was found to have a tuberculous udder. The herd was retested in September, 1959, when 19 animals were found to be positive reactors. These animals, together with a few doubtful reactors, were slaughtered, the result being the destruction of the entire milking herd. The cause of the breakdown in the herd was not established, but it was suggested that a cow which had been sold off the farm to a knacker, prior to July, 1959, may have been the originator of the herd infection.

The bulk of the milk from this herd had been sent daily for pasteurization before retail to the general public.

In November, 1959, a general practitioner informed the medical officer of health for Oxfordshire that a girl