

# A Child with a Ring G Chromosome (46,XX,Gr)

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Ring chromosome formation and deletion or monosomy of a G-group autosome has now been observed in a number of patients with mental retardation and congenital abnormalities (Polani, 1969). This brief report described the clinical, cytogenetic, and other laboratory findings in a child with a ring G chromosome.

## Case Report

The patient was first seen at the age of 4 years 2 months because of persistent vomiting and failure to thrive. She was born in July 1965 at 38 weeks gestation after an uncomplicated pregnancy and a normal delivery; the birthweight was 2818 g. She was the eldest of four sibs of unrelated healthy parents aged 24 (father) and 22 years (mother) at the time of her birth. The mother had no known miscarriages. Four generations of the family were reviewed without uncovering any birth defect or hereditary disorder. Two days after the birth, the parents were informed that the baby was a mongol.

Mental and motor development was slow. She sat up at 15 months, stood at 24 months, and walked at 42 months. She also failed to develop any speech. Apparently she thrived quite well until 8 weeks before admission to hospital in October 1969, when she began vomiting after every meal. This became persistent with evidence of dehydration and weight loss (4 kg).

Examination revealed a thin, pale, and apathetic child. She measured 85 cm (below 3rd centile) in length, weighed 8.6 kg (below 3rd centile), and had a head circumference of 49 cm. Though she had an odd facies, her appearance did not suggest mongolism. The bridge of the nose was broad and prominent; and the ears were large and low set. The eyes were normal, except for a slight antimongoloid slant to the palpebral fissures. She also had micrognathia and a high arched palate. The heart, lungs, and abdomen were normal. There was no abnormality of the central nervous system.

The stools were bulky, pale to almost white, and contained little or no bile pigment. There was no urobilinogen in the urine. The faeces contained no sugars and had a normal amino acid pattern. On no occasion was the patient jaundiced nor did her plasma bilirubin

rise. The bulky stools (total 4-day fat excretion 59.7 g) indicated malabsorption but her total blood folate and glucose tolerance test were normal. A barium meal examination showed no evidence of malabsorption.

**Laboratory studies.** The haemoglobin was 13.0 g/100 ml, with a white cell count of 13,300/mm<sup>3</sup>. Routine urinalysis was normal. The urinary amino acid chromatogram revealed a normal pattern with the excretion of a large quantity of  $\beta$ -aminoisobutyric acid. There were also traces of galactose, glucose, sucrose, and lactose; indican was present in excess. Fasting plasma amino acids were also normal except for threonine and glutamine which were lower than normal. The plasma aminonitrogen was 5.7 mg/100 ml (normal range 3.6 to 5.4 mg/100 ml). The total plasma proteins was 7.5 g/100 ml with normal electrophoresis. Serum immunoglobulins, plasma cholesterol, and protein bound iodine were normal. Skull x-ray showed that the vault was relatively widened in the biparietal area with a flattened occiput. The pituitary fossa was normal. The bone age determined at the wrist was retarded (age 2 to 2½ years).

In November, the patient suddenly collapsed, and within a short time was almost moribund. Intravenous fluids and hydrocortisone produced some improvement over the next 24 hours but later her condition deteriorated and she died two days later.

**Necropsy** (Dr F. E. O'Brien). There was fatty change in the liver, left renal vein thrombosis, haemorrhagic infarction, and necrosis of the left kidney, an acute ulcer at the lower end of the oesophagus, hydropericardium, hydroperitoneum, bilateral hydrothorax, and bilateral bronchopneumonia. The meninges of the brain were not inflamed. The pattern of gyri was normal.

**Dermatoglyphic analysis.** The dermatoglyphic findings are summarized in Table I and Figure 1. The axial triradii ( $\epsilon$ ) were normally situated but the C tri-radius was missing on both palms. There were no single transverse palmar creases. A whorl pattern was present in the hallucal areas.

**Blood group types.** The results of these determinations are presented in Table II and provide no evidence of linkage with the abnormal chromosome.

TABLE I  
FINGERTIP PATTERNS, FINGER RIDGE COUNTS

|                    | Left |    |     |      |     | Right |     |     |      |     |
|--------------------|------|----|-----|------|-----|-------|-----|-----|------|-----|
|                    | I    | II | III | IV   | V   | I     | II  | III | IV   | V   |
| Fingertip pattern  | A    | A  | W   | W    | U   | A     | R   | U   | U    | U   |
| Finger ridge count | 0    | 0  | 8/9 | 10/8 | 8/0 | 0     | 0/9 | 7/0 | 11/0 | 8/0 |

Total ridge count = 62.

TABLE II  
BLOOD GROUP TYPES

|            | ABO            | Rh      | MN | S | P <sub>1</sub> | Lu <sup>a</sup> | K | k | Kp <sup>a</sup> | Le <sup>a</sup> | Fy <sup>a</sup> | Fy <sup>b</sup> | Jk <sup>a</sup> | Jk <sup>b</sup> | C <sup>w</sup> | W <sub>r</sub> <sup>a</sup> |
|------------|----------------|---------|----|---|----------------|-----------------|---|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|-----------------------------|
| Propositus | 0              | CDe/CDe | MN | - | +              | -               | - | + | -               | -               | +               | +               | -               | +               | -              | -                           |
| Father     | A <sub>1</sub> | CDe/CDe | MN | - | -              | -               | - | + | -               | -               | +               | +               | -               | +               | -              | -                           |
| Mother     | 0              | CDe/cde | M  | + | +              | -               | - | + | -               | -               | +               | -               | +               | +               | -              | -                           |

**Cytogenetic analysis** (Fig. 2). Peripheral blood was cultured by a modification of the method of Robinson *et al* (1964). In 41 well-spread cells the modal number was 46; one cell contained 45 chromosomes and 40 cells each had 46 chromosomes. An abnormal small acrocentric chromosome of the G group was present in every cell. There was little variation in the size of this abnormal chromosome, and in 80% of the cells a ring chromosome could be clearly identified. The other chromosomes were normal. The buccal smear was chromatin positive.

Chromosome studies on both parents and the sibs were normal.

**Discussion**

The occurrence of monosomy or deletion of a group G chromosome has been reported in several patients with mental retardation and multiple abnormalities (Polani, 1969). In 1964, Lejeune and his collaborators described a mentally retarded child with multiple abnormalities and an unusual

autosomal mosaicism involving a G group chromosome. One cell line consisted of 45 chromosomes with one G chromosome missing and the other cell line had 45 chromosomes plus a minute fragment which was probably a ring chromosome. As the

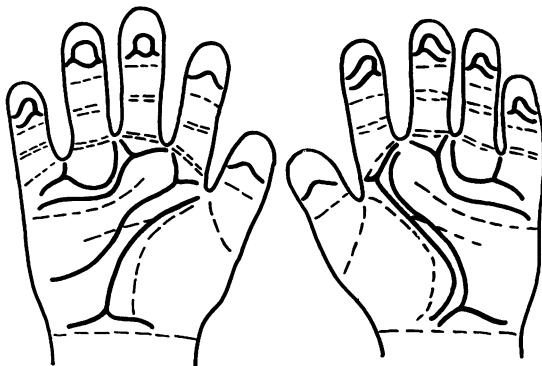


FIG. 1. Dermatoglyphic patterns. Note missing C triradii.



FIG. 2. G group chromosomes of different metaphases, illustrating various forms of the ring chromosome.

clinical features appeared antithetical to those of mongolism, the authors suggested the term 'le contre-type' trisomy 21. An infant with similar physical and cytogenetic findings was reported by Reisman *et al* (1966) who referred to the condition as 'antimongolism'.

A comparison of the clinical appearance of these patients with subsequent cases (German and Bearn, 1962; Thorburn and Johnson, 1966; Hall, Frega, and Svenningsen, 1967; Hindle, 1967; Al-Aish *et al*, 1967; Endo *et al*, 1969; Challacombe and Taylor, 1969) suggests that they constitute a definite syndrome. The major features are physical and mental retardation, hypertonia, failure to thrive, and an abnormal facies. The facies had palpebral fissures that sloped downwards and outwards (antimongoloid), a prominent nasal bridge, low set malformed ears, and micrognathia. Many of these features were present in our patient.

Persistent vomiting shortly after birth was a prominent feature in several cases, and in some this was caused by hypertrophic pyloric stenosis (Lejeune *et al*, 1964; Reisman *et al*, 1966; Challacombe and Taylor, 1969). The present patient developed persistent vomiting for the first time at the age of 4 years, but investigations and necropsy failed to show the cause for the vomiting and malabsorption.

Several cytogenetic variants of antimongolism have been observed: apparent monosomy G (Thorburn and Johnson, 1966; Hall *et al*, 1967; Al-Aish *et al*, 1967); deletion Gq- (German and Bearn, 1962; Reisman *et al*, 1966; Hindle, 1967); and mosaicism Gq-/G- (Lejeune *et al*, 1964; Endo *et al*, 1969; Challacombe and Taylor, 1969). It is possible that among the reported cases of deletion of a G chromosome may have been some in which the true abnormality was a ring chromosome (German and Bearn, 1962; Lejeune *et al*, 1964; Challacombe and Taylor, 1969). The recognition of a ring G chromosome is difficult because of the size of the acrocentric chromosomes in this group. The abnormal chromosome in our patient was clearly identifiable as a ring G chromosome.

Similar cytogenetic findings have been observed in patients who, though mentally retarded, did not have the somatic abnormalities associated with the antimongolism syndrome (Reisman *et al*, 1967; Hoefnagel *et al*, 1967; Weleber, Hecht, and Giblett, 1968; Bauchinger, Schmid, and Röttinger, 1968; Blank and Lorber, 1969). An explanation for the diverse clinical features associated with monosomy or deletion of a G group chromosome may be that deficiencies for the 21 and 22 chromosome are combined as one group. Unfortunately, autoradiographic studies have been available in only a

few of the reported cases. It is interesting, however, to note that in the case reported by German and Bearn (1962), autoradiography has shown that the ring was a late replicating G autosome (German, 1967), whereas in the patient described by Hoefnagel *et al* (1967) in whom the specific somatic abnormalities of antimongolism were lacking, the ring belonged to the earlier replicating G autosome. On the other hand, in the patient described by Weleber *et al* (1968), autoradiography failed to show whether the ring was early or late replicating. When more patients with these cytogenetic findings have been studied it may be possible to separate them into distinguishable G deletion syndromes.

### Summary

A patient in whom a ring G chromosome was found presented with persistent vomiting and failure to thrive. She had physical and mental retardation with an antimongoloid slant to the palpebral fissures, a broad and prominent nasal bridge, low-set ears, micrognathia. A comparison with cases of similar chromosomal findings suggests she resembles the antimongolism syndrome.

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