Ring chromosome 8 in a boy with multiple congenital abnormalities and mental retardation

SUMMARY A ring chromosome 8 was found in peripheral blood cells in a boy, whose chromosomes were studied because of multiple congenital anomalies. Examination of skin cells revealed a 46,XY/46,XY,8r pattern. Application of several banding techniques suggested a duplication of the most distal bands of both arms in the ring. The terminal end of 8q appeared to have been retained as could be shown by R-banding.

The anaesthesia and surgery the mother underwent in the first month of her pregnancy is considered as a possible cause of the chromosome abnormality.

Ring chromosomes derived from unidentified C chromosomes have been reported in several cases.

After the development of the banding techniques the possibility of identifying the origin of C ring chromosomes led to the publication of reports of 4 patients with a ring chromosome 6 (Moore et al., 1973; Van den Berghe et al., 1974; Fried et al., 1975; Wurster-Hill and Hoefnagel, 1975), 2 patients with a ring chromosome 7 (Zackai and Breg 1973), 1 patient with a ring chromosome 8 (Pfeiffer and Lenard, 1973), and 5 patients with a ring chromosome 9 (Kistenmacher and Punnett, 1970; Jacobsen et al., 1973; Fraisse et al., 1974; Zdansky et al., 1975; Nakajima et al., 1976). In the case of Kistenmacher and Punnett the identification was based on morphology and study of the exchange pattern induced by mitomycin C.

In this paper a ring chromosome 8 is described in a patient who was studied because of multiple congenital abnormalities.

Case report

The propositus (born 13 October 1967) is the first of two children. At birth his mother was 25 and his father was 28 years old. There were no abortions or stillbirths. Unaware of her pregnancy the mother underwent an appendectomy on account of chronic appendicitis on the 18th day of her last menstrual cycle (premedication: 0.5 mg atropine, 25 mg promethazine, 20 mg pantopon; narcotics: thiopenthone-sodium, suxamethonium-chloride, nitrous oxide, and fluothane).

Gestation was uneventful and ended 13 days after term. Birthweight was 2770 g, length 47 cm. Feeding was very difficult in the neonatal period.

At 1½ years of age the boy suffered from feverish convulsions. When he was 2½ years old he was operated on for bilateral hernia inguinalis. Because of an impending dislocation of the right hip, he was treated with a stretch bandage at the age of 2½ years. He suffered from recurrent infections of the upper respiratory tract. Psychomotor development was very retarded.

At the age of 5½/12 years the boy was admitted to our institution. Physical examination at that time disclosed the following (Fig. 1A and B): dwarfism, dolichocephaly, prominent occiput, asymmetry of the viscerocranium, bilateral strabismus convergens alternans, bilateral epicanticth folds, asymmetric ears, tight upper lip, thin lips, gothic palate, asymmetry of the upper dental arch, micrognathia, pectus excavatum, scapulae alatae, wide-spaced areolae mammae, long thorax, bilateral inguinal scars from herniotomy, sacral dimples, and dimples dorsal of the elbows, camptodactyly of both fifth fingers, hypotonia, and cutis marmorata.

The electroencephalogram was normal. Ophthalmological examination revealed a distinct bilateral hypermetropia and minor astigmatism of the right eye, which seems to be affected by amblyopia.

X-ray examination revealed that the right caput femoris was located laterally in the acetabulum and that the right femur was adducted, the right side
of the pelvis was in a higher position than the left side, both tibiae showed minor exostosis, and the sacral arches were cleft. The chest organs showed no abnormalities.

Results of biochemical examination of blood and urine were normal.

With the Griffiths Mental Development scales the General Quotient proved to be 36.

The dermatoglyphic data of the propositus and his parents are pictured in Fig. 2 and summarised in the Table.

CYTOGENETICS

Chromosome examinations were carried out on peripheral blood cells and by means of a skin fibroblast culture of the patient.

G-banding of the chromosomes was studied with the trypsin-Giemsa technique, Q-banding by fluorescent staining with atbrin, and R-banding with acridine orange with and without BrdU pretreatment. The total number of leucocytes examined was 120. In 118 of these cells 46 chromosomes were present. One had a normal complement but in 117 cells a C chromosome was missing and replaced by a ring (Fig. 3). Of two further cells one had 45 chromosomes without a ring and one had 47 chromosomes with two rings.

Ring size and morphology were constant. In only 5 cells were double rings found, indicated by two blocks of heterochromatin (Fig. 4b). In most of the cells microscopical examination suggested that the circumference of the ring was somewhat greater than the length of the normal chromosome 8.

In 72 fibroblasts examined the ring was found only in 8 cells, 5 of which had 47 chromosomes while in 3 cells random elements were missing. The remainder of the cells had a normal set of chromosomes.

In cells with a ring the banding techniques revealed that in the C-X group there was only one normal number 8 chromosome (Fig. 3). To get a more precise insight into the number and origin of the bands present in the ring, BrDU pretreated cells were photographed after AO staining and rephotographed after C-banding the same cells. In this way the location of the centromere in the R banded ring could be clearly traced back (Fig. 5). Comparison of the bands on the ring with these on the normal chromosome 8 showed that all bands detectable in the latter were present in the ring. Besides that, suitable cells suggested that the most distal bands on both arms were wider in the ring than in the normal homologue. This impression was strengthened by reflection photometer scanning which indicated that these bands were present in duplicate in the ring. The most striking feature of the ring revealed by the R-banding was that the terminal end of 8q appears to have been retained in the ring (Fig. 4c).

The chromosomes of both parents were normal.

Discussion

Ring chromosomes are thought to be the result of double terminal deletions followed by reunion of the

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Case reports

Fig. 2 Dermatoglyphic patterns of the propositus and his parents.

Fig. 3 G-banding (above) and Q-banding (below) of the C-X chromosomes of the propositus.
broken ends carrying the centromere. The results of the studies of Kunze et al. (1972) on the symptoma-
tiology of patients with a ring chromosome 18 support this theoretical mechanism. They found that a ring 18 syndrome cannot be exactly separated from the 18p- or 18q—clinical pictures and that in patients with a ring 18 chromosome the symptoms of both the deletion syndromes were overlapping. However, only three patients with a deletion of the short arm and none with a deletion of the long arm of chromosome 8 are known to us (Lubs and Lubs, 1973; Taillemite et al., 1975; Orye and Craen, 1976). The features in common in these and our patient are, however, unspecific, and are seen in a wide variety of chromosomal disorders.

Nine case reports of unidentified C ring chromo-
somes are available from the literature, in two of which gonosomal origin could not be excluded. In 11 other patients described the ring was identified but was found to be derived from a C chromosome other than an 8. Only one patient with a ring 8 chromosome is known to us (Pfeiffer and Lenard, 1973). The phenotype of this patient does show some resemblance to the present case. Both have a low birth-
weight, short stature, a dolichocephalic skull, gothic palate, abnormal dentition, and micrognathia. Mental retardation seems to be more serious in our case.

Remarkably enough, in both patients most fibroblast cells have a normal karyotype so that in fact they are mosaics 46,XY/46,XY,8r.

The anaesthesia the mother of our proband under-
went in the first month of her pregnancy during an appendectomy could be the cause of a mitotic distur-
bance early in embryogenesis giving rise to the abnormal cell line of the mosaic pattern.

The fact that the reflection photomicrograph scanning indicated a duplication of the most distal bands of short and long arms of the normal chromosome 8 in the ring chromosome suits well with the theory of Lejeune (1968) on ring behaviour. He states that ring duplication during mitosis gives rise to rings of different size and with different genetic content as result of sister chromatid exchanges. This pheno-
menon and the possible divergent proportions of normal and abnormal cells make a comparison of the phenotypes of ring patients precarious.

An intriguing feature in the ring of the patient studied is the fact that the terminal bands of the long arms of the original chromosome appear to have been retained in ring formation.

H. E. Wyandt (1974, personal communication) found this in three other cases, where at least one end of the chromosomes appeared to be unaffected. The generally accepted mechanism of telomeric deletions and subsequent reunion, on the basis of this finding, needs revision or at least additional attention.
The authors are indebted to Dr J. B. Bijlsma (Amsterdam) for the reflexion photometer scanning and to Dr H. E. Wyandt (Portland) for carrying out the R-bandign.

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An interstitial deletion of chromosome 9 in a girl with multiple congenital anomalies1

SUMMARY  An infant with peculiar facies, coloboma of both eyes, and developmental retardation was found to have a de novo interstitial deletion of the secondary constriction and some adjacent euchromatin on one of her No. 9 chromosomes, del(9) (q11q21). Since studies on duplications, variants, and the molecular composition of the secondary constriction suggest that it contributes little if any information necessary to normal development, deletion of the euchromatin alone is most probably responsible for the clinical findings.

An extensive literature now exists on the various trisomies of chromosome 9 and their clinical significance (Sutherland et al., 1976). In contrast relatively few data are available regarding deletions of this chromosome. Alfi et al. (1976) have studied 6 patients with deletions of the short arm distal to 9p22 and have found consistency in the resulting clinical malformations. Smith et al. (1973) reported a unique long arm deletion with associated persistent fragments in a severely malformed boy. In this case, specific identification of the deleted material was difficult. An institutionalised male with a 46,XY,9q deletion karyotype was reported by Newton et al. (1973). The deleted segment in this patient was identified as the secondary constriction. Ring chromosomes resulting from elimination of small amounts of distal chromosomal material have been reported by Jacobsen et al. (1973) and Kistenmacher et al. (1975).

We wish to report our observations on a child with a new deletion, one which resulted in loss of the secondary constriction and a small amount of adjacent euchromatin. The patient presented with developmental retardation and multiple congenital anomalies.

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