13S+. Giant Satellites or de Novo Rearrangement?

K. Imaizumi¹, T. Kajii¹, and N. Niikawa²

¹Department of Pediatrics, Yamaguchi University School of Medicine, Ube, Japan 755
²Department of Pediatrics, Hokkaido University School of Medicine, Sapporo, Japan 060

Summary. A seven-year-old Japanese girl with mental retardation, epileptic seizures controllable by anticonvulsants, short stature, and multiple minor malformations was found to have apparent giant satellites on chromosome No.13. The karyotypes of her parents and elder brother were normal. Banding studies revealed that the apparent giant satellites consist of four G-bands, and are thus a de novo rearrangement product. The origin of the aberrant No.13 was traced to a paternal meiotic error, using Q-banding and silver staining heteromorphisms as markers. Thus, the patient represents an unbalanced, de novo chromosomal rearrangement masquerading as giant satellites, with the origin of the extra chromosomal material unknown, a hitherto undescribed situation.

Introduction

Giant satellites of the acrocentric chromosomes are usually considered a normal variant, a trait without phenotypic effect, and are usually inherited. A few instances, however, have been reported in which apparent giant satellites were not a normal variant but the product of reciprocal translocation. Wilson et al. (1973) described a de novo translocation t(7q-;13S+) in an infant with craniosenosis and retardation. Chiyo et al. (1975) reported apparent giant satellites in a malformed and mentally retarded infant, whose father was a balanced t(6p-;15S+) translocation carrier. The infant was thus trisomic for the distal part of 6p.

We describe a mentally retarded and malformed girl with apparent giant satellites on chromosome No.13. Detailed cytogenetic studies revealed that the satellites consist of at least four bands, and are thus most likely a de novo translocation product.

Case Report

K.S., a 7-year-old girl, was born at 40 weeks' gestation to a 33-year-old mother and a 38-year-old father, both healthy and unrelated. The mother's first pregnancy ended in a spontaneous abortion at three months, and the second pregnancy resulted in the birth of a healthy boy. The patient weighed 3,030 g at birth. Feeding difficulties, poor weight gain, and weak cry were noted during early infancy. Her developmental milestones were delayed: head control was achieved at three months of age, she sat unsupported at eight months, talked a word at 12 months, and walked unsupported at 18 months. She scarcely smiled. At 12 months of age, she had an episode of afebrile tonic-clonic seizure of 15 min duration, and later had a convulsion at age two years and another at age three. An anticonvulsant (name unknown) treatment was started at age three years. When first seen by us at seven years of age, her height was 103.5 cm (−3 SD), head circumference 46.5 cm (−2.2 SD), and weight 15.0 kg (−2.3 SD). She had a high bridge of the nasal root and large palpebral fissures without epicanthal folds (Fig. 1). The ears were low-set with incompletely outfolded scapha helix. She

Fig. 1. The patient at age 7 years
Fig. 2A—C. Chromosomes 13 of the patient. A Sequential conventional Giemsa staining (upper row) and trypsin-G banding (lower row). B Trypsin-G banded chromosome 13s+ in prometaphase. Four G-bands in the satellite region. C Sequential Q- and R-banding. The short arms of the 13s+ chromosome are Q-banding positive, while the satellite stalks of the same chromosome are R-banding positive.

Fig. 3. Maternal (M) and paternal (P) chromosomes 13, and those of the patient, Q-banded. The aberrant chromosome 13 is of paternal origin.

had bilateral short incurved fifth fingers. Her IQ was estimated at 55. Electroencephalography during sleep revealed 3c/s spikes in the right central leads. Routine laboratory examinations were within normal limits, as were the serum levels of amino acids, immunoglobulin, growth hormone, T3, T4, and creatinine phosphokinase. The bone age corresponded to her chronological age.

Cytogenetic Studies

Chromosome preparations were made from short-term cultures of the peripheral blood lymphocytes from the proposita, her parents and elder brother. Routine chromosome analyses revealed that the proposita had a 46,XX,Ds+ karyotype, while her parents and elder brother had normal karyotypes.

Fig. 4. Silver-stained D-group chromosomes. The satellite stalks of the aberrant chromosome 13 of the patient, intensely stained, were derived from a paternal chromosome 13.

Conventional Giemsa staining followed by trypsin-Giemsa banding (Fig. 2A; Kajii et al. 1972) identified the Ds+ chromosome as a No. 13, with the “giant satellites” composed of four G-bands. G-banding of prometaphase chromosomes supported this interpretation (Fig. 2B). The “giant satellites” consisted of four G-bands: a proximal band of medium staining intensity, a pale band, a darkly stained band, and a distal pale band. Search for possible deletion of chromosomal material, corresponding to that on the giant satellites, in G-banded karyotypes of both the proposita and her parents revealed no such deletion.

Sequential Q- and R-banding (Niikawa and Kajii 1975) revealed that the 13s+ chromosome had Q-band positive giant satellites and R-band positive satellite-stalks (Fig. 2C). The origin of the 13s+ was studied using Q-banding and silver staining (Kodama et al. 1980) heteromorphisms as markers (Figs. 3 and 4). The chromosome 13, with strongly fluorescent short arms and intensely silver-stained satellite-stalks, was inherited from the father. The satellites on the paternal chromosomes 13 were of normal size. Therefore, the “giant satellites” on the proposita’s No. 13 most likely arose from a paternal meiotic error, probably from a reciprocal translocation between the No. 13 and another unidentified chromosome.

Discussion

Both our patient and that of Wilson et al. (1973) illustrate the importance of detailed banding studies in non-inherited “giant satellites”, even though the “giant satellites” do not always indicate translocation of euchromatic chromatin that exerts phenotypic effects. Nakagome et al. (1977) reported giant satellites 22s+, not inherited from the parents, in a mentally retarded and malformed girl. The satellites consisted of C-band-positive heterochromatin which is not likely to exert a phenotypic effect. The very absence of phenotypic effect perhaps guarantees the perpetuation of normal variants in the general population. Chromosome rearrangements that exert phenotypic effects are rare, presumably because they are quickly eliminated from the general population.

The origin of the extra material on 13s in our patient is unknown. Her clinical features included mental retardation,