Case Study

Case Report of Mosaic Ring Chromosome 13:
46,XX,r(13)(p13q34)/46,XX,dic r(13;13)(p13q34;p13q34)

ABSTRACT

Aims: To report a case of ring chromosome 13 in a female child.

Presentation of case: Female, Caucasian, born in Southeast of Brazil, 6 years old. Born by cesarean section, the physical examination at 6 years and 1 month old has shown: weight of 19.100 grams and 105 centimeters tall, developmental delay, bushy eyebrows, epicanthic folds and broad nasal bridge, cardiovascular and respiratory systems were normal and no abnormalities in the limbs. Chromosome analysis was performed by GTG banding of peripheral blood and the karyotype was 46,XX,r(13)(p13q34)[97]/46,XX,dic r(13;13)(p13q34;p13q34)[3]. Analysis of 100 metaphases following in G-banding revealed 97% cells with a ring chromosome 13, 3% with of dicentric ring chromosome of two 13s, and no Aneuploidy was not detected found. Her parents had a normal karyotype.

Discussion: Some researchers relate the clinical presentation of ring chromosome 13 cases with the extension of the deleted chromosomal region and instability. Others suggested that phenotypes of patients can be categorized in groups, according to the breakpoint on 13q.

Conclusion: The classification of cases in groups based on through breakpoints and chromosomal instability is still inaccurate, with variable phenotypes. Thus, the analysis of a greater number of cases and molecular analysis are important to establish more precise correlation between genotype and phenotype.

Keywords: ring chromosome 13; mental retardation; 13q deletion syndrome; chromosome abnormality

1. INTRODUCTION

The ring chromosome 13 is a rare genetic condition. It was first described in 1968 by Lejeune et al. [1] with an estimated incidence of 1 in 58,000 live births incidence. The familial transmission of this chromosome was described in 2004 by Bedoyan et al. [2]. Features of r(13) include intellectual disability, facial dysmorphisms, microcephaly, and hypertelorism [3].

Ring chromosomes have been reported for all chromosomes homologous pairs; however, those involving chromosomes 13 and 18 are among the most common [4]. When ring chromosomes replace a normal homolog in a karyotype, they often represent a partial monosomy for both long and short arm material. When rings are present as supernumerary chromosomes, partial trisomies are a result [5].
In patients with ring chromosomes, sister chromatid exchanges occurring during mitosis usually result in secondary chromosomal abnormalities, such as dicentric rings, interlocked rings, and others structural conformations (fig. 1). These unstable chromosomes can also lead to ring chromosome loss, producing monosomic cells, which may or may not be viable [6].

According to Bedoyan et al. [2] 99% of the formation of ring chromosomes occurs sporadically. Here we report a case of ring chromosome 13 in a female child and compare the findings with other reported cases with breakpoints at p13q34.

2. PRESENTATION OF CASE

Our patient was referred to the Center of Reference and Treatment of Children and Adolescents (Campos dos Goytacazes, RJ, Brazil) due to mental retardation and speech delay. At 5 years and 7 months of age, she had difficulties in cognition and language. She couldn’t recognize letters of the alphabet. The child was used to show interest in school cognitive activities, but concentration was difficult. She crawled at 9 months of age, walked at 1 year and 4 months and showed normal dentition at 10 months. Hearing and vision were normal and the child had good social interaction and a docile behavior.

The patient’s parents were normal and non-consanguineous, and her older sibling was born a normal child. The first fetal movement was noticed at 3 months of pregnancy and the mother had suffered from gestational diabetes. The baby was born through cesarean section. Her weight and height were 2.910 grams and 46 cm, respectively.

The physical examination at 6 years and 1 month of age revealed: weight of 19.100 grams and 105 centimeters tall, growth retardation, developmental delay, mental retardation, facial dysmorphism, bushy eyebrows, epicanthic folds and broad nasal bridge, cardiovascular and respiratory systems were normal and there were not abnormalities in the limbs.

2.1 Cytogenetic Study

Routine chromosome preparations were made from peripheral blood lymphocytes after 72h in culture with RPMI-1640 supplemented with 20% fetal bovine serum and phytohemagglutinin (PHA). The G banding technique (400 bands) was applied to analyze cells from the patient and her parents. The chromosomes were classified according to ISCN (2013) [6].
Cytogenetic studies were performed according to standard methods described by Verma and Babu [7] and showed mosaic ring chromosome 13 with karyotype with 46,XX,r(13)(p13q34)[97]/46,XX,dic r(13;13)(p13q34;p13q34)[3]. The number of cells counted, karyotyped and analyzed were 100, 20 e 10, respectively, and revealed: 97% of the cells had a karyotype with 46,XX,r(13)(p13q34) karyotype and 3% karyotype with 46,XX,dic r(13;13)(p13q34;13q34) pattern (Fig. 1A and 1B). No loss of any chromosomal band could be identified in the ring chromosome 13 at the 400- to 500-band level. The parents had a normal karyotype.

![Fig. 1. Partial G-banded karyotype of the patient. A. The normal and the ring chromosome 13. B. The normal and the dicentric ring chromosome 13.](image)

### 3. DISCUSSION

In the present study we compare phenotypes of a patient with other reported cases in literature for r(13) with breakpoint in p13q34 (Table 1), previously described by Lowry and Dill [8], McCorquodale et al. [9], Bedoyan et al. [10], Kim et al. [11], and P.-H. Su et al. [3] and Ballarati et al. [16].

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<td>M</td>
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<td>37</td>
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<td>37</td>
<td>Full term</td>
<td>40</td>
<td>NI</td>
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<td>Birth weight (g)</td>
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<td>2155</td>
<td>3090</td>
<td>1860</td>
<td>2060</td>
<td>3000</td>
<td>2910</td>
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<td>Birth length (cm)</td>
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<td>48</td>
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Table 1. Comparison of clinical features of our patient with other r(13)(p13q34) cases.
### Table 1

<table>
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<tr>
<th>Maternal age (year)</th>
<th>23</th>
<th>17</th>
<th>18</th>
<th>28</th>
<th>25</th>
<th>Ni</th>
<th>30</th>
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<td>+</td>
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<td>+</td>
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<td>+</td>
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<td></td>
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<tr>
<td>Growth retardation</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Epicanthic folds</td>
<td>+</td>
<td>+</td>
<td>Ni</td>
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<td>Facial dysmorphism</td>
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<td>+</td>
<td>-</td>
<td>+</td>
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<td>Broad nasal bridge</td>
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<td>Vision anomalies</td>
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<td>-</td>
<td>Ni</td>
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<tr>
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<td>Ni</td>
<td>-</td>
<td>Ni</td>
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<tr>
<td>Hard palate</td>
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<tr>
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<td>Ni</td>
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<tr>
<td>Genital malformations</td>
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### Table 2

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<th>p13q34</th>
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<th>p13q34</th>
<th>p13q34</th>
<th>q34-qter</th>
<th>p13q34</th>
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<td>Counted cells</td>
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<td>500</td>
<td>100</td>
<td>50</td>
<td>100</td>
<td>Ni</td>
<td>100</td>
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<td>45,-r(13) (%)</td>
<td>0</td>
<td>0-2</td>
<td>0</td>
<td>3</td>
<td>14</td>
<td>Ni</td>
<td>0</td>
</tr>
<tr>
<td>46, r(13) (%)</td>
<td>95</td>
<td>96</td>
<td>100</td>
<td>44</td>
<td>82</td>
<td>Ni</td>
<td>97</td>
</tr>
<tr>
<td>46,r(13) dicentric (%)</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>Ni</td>
<td>3</td>
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<tr>
<td>Chromosome 13 mar (%)</td>
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<td>0</td>
<td>0</td>
<td>2</td>
<td>Ni</td>
<td>0</td>
</tr>
</tbody>
</table>

F, Female; M, Male; Ni, No Information

Our findings are consistent with those from literature and emphasize three pathognomonic features of ring chromosome 13 syndrome: mental retardation, developmental delay and facial dysmorphism. Descriptions as anomalies in upper and lower extremities were uncommon, whereas mental retardation was predominant, being present in all the cases described. The reported cases with the most severe phenotypes showed secondary chromosomal abnormalities (dicentric chromosomes or chromosomes in interconnected ring) and/or aneuploidy (hypoploidias, chromosome loss). Secondary abnormalities were not seen in the case of Bedoyan et al. [2], and the only clinical feature described was mental retardation, which reinforces the hypothesis of the influence of instability on the phenotype of patients with the syndrome. Previous studies suggested that cells with secondary abnormalities would not be able to survive in vivo and
would be eliminated in subsequent cell divisions [12]. This hypothesis could explain some
phenotypic changes such as reduced body mass and growth retardation in these patients.

Some authors relate the clinical presentation of “ring chromosome 13 syndrome” with the
size of the ring chromosome and ring stability [13], while others did not find a correlation
between r(13) and size of the ring chromosome and ring stability [14].

Based on clinical features, these deletions have been categorized into three groups [15].
Group 1 deletions comprise the chromosome region proximal to 13q32 and are
characterized by mild to moderate mental retardation and variable facial dysmorphic
features. Deletions of 13q32 (Group 2) are associated with the most severe phenotype, often
including malformations of the brain, eyes, distal limbs, and the genitourinary and
gastrointestinal tract. Patients with 13q32 deletions invariably have severe mental
retardation and short stature. Distal deletions of bands 13q33–34 (Group 3) cause mental
retardation, microcephaly, and genital malformations in males, but are normally not
associated with other major malformations [16].

According to this classification, our patient may be related to Group 3, though she does not
present microcephaly. In a previous study performed by Kosztolányi [12], a ring
chromosome was considered to be “stable” when secondary aberrations were found in 0-5% of
the mitoses and “unstable” when such aberrations occurred in more than 5% of the
mitoses counted.

The clinical case described here presented approximately 3% the cells with secondary
chromosomal abnormalities, which according to this parameter, can be considered “stable”.
Thus, the phenotype will actually depend on the size of the ring chromosome, the amount of
euchromatin lost during ring formation, the ring stability, the presence of secondary
aneuploid cells, and the rate of mosaicism [13]. However, studies of Sodré et al. [4]
concluded that the instability of ring chromosomes had not shown a clear relationship
between ring size and its instability. Based on this study, we concluded that the ratio of
mitotic stability related to clinical severity should be evaluated with caution.

4. CONCLUSION
In conclusion, the classification in groups through breakpoints and chromosomal stability is
still inaccurate, with variable phenotypes. However, it is generally accepted that the severity
of clinical cases is directly related to the amount of genetic material lost. Ring chromosomes
with breaks in p13q34 are very rare and a few reports have been recorded so far. Thus, the
analysis of a greater number of cases and molecular analyses of a greater number of cases
are important to establish more precise correlation between genotype and phenotype.

COMPETING INTERESTS
Authors have declared that no competing interests exist.

CONSENT
All authors declare that written informed consent was obtained from the parents of the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

REFERENCES


