Meiotic behaviour of two human reciprocal translocations

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SUMMARY The meiotic behaviour of two male human reciprocal translocations is described. One patient had an unbalanced son and a chain configuration. The second had a stillborn child and a ring corresponding to an adjacent I segregation. The meiotic behaviour of chromosomal rearrangements must be investigated for proper genetic counselling.

According to the data of Jacobs *et al*¹ the incidence of balanced chromosomal rearrangements in the adult population is 3.32 per 1000. The most common type is the translocation. In newborns² the incidence of balanced reciprocal translocations is less than 1 in 1000, but in subfertility clinics the incidence is much higher. In our series of 1015 subfertile males (up to 31 May 1980) in whom mitotic or meiotic studies or both have been carried out, we have found five reciprocal translocations. In spite of the prognostic importance of the meiotic behaviour of the translocation products, to our knowledge only ten cases have been published.³⁻⁸

In this paper we describe the meiotic findings in two subfertile males, heterozygous for reciprocal translocations.

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Material and methods

The two cases were referred for chromosome studies by the Department of Andrology, Fundación Puigvert. Peripheral blood cultures were carried out using commercial kits and analysed by G banding⁹ and Q banding.¹⁰ In case 1 meiosis was studied in semen using the technique of Sperling and Kaden¹¹ as modified by us.¹² In case 2 a testicular biopsy was obtained under local anaesthesia and meiotic preparations were made using the technique of Evans *et al*.¹³

Results

CASE 1. 46,XY,t(10;13)(q25;p12)

This patient, aged 34, had a son with mental

FIG 1 Diakinesis and chain configurations in the carrier of a (10;13) translocation.

TABLE Meiotic behavior of 12 reciprocal translocations

Reference	Translocation	Meiotic configuration		Sperm count (million/ml)	Offspring
		RIV (%)	CIV (%)		
3	46,XY,t(C;C)	—	100	—	Son with balanced translocation Daughter unbalanced
4	46,XY,t(Cp-;Eq+) 46,XY,t(9;22)(q12;p1)	60.5	—	Azoospermic	—
5	46,XY,t(1;18)(q32;q21) 46,XY,t(9;22)(q21;q11)	100 65.8	95.5 34.2	31	Two miscarriages Daughter, normal chromosomes Miscarriage Stillborn, multiple malformations
6	46,XY,t(9;14)(q22;q32)	99	1	7.5	—
7	46,XY,t(5;6)(q22;q13) 46,XY,t(10;13)(q25;q11) 46,XY,t(9;11)(q34;q13) 46,XY,t(2;11)(q21;q25)	100 40 100	60 100	23 Oligozoospermia Oligozoospermia	Normal daughter Normal son Son and daughter with malformations, died after birth Son with partial trisomy 10q Stillborn, multiple malformations
This report	46,XY,t(10;13)(q25;p12) 46,XY,t(5;7)(q13;q11)	100	100	0.8 38	—

retardation. Lymphocyte metaphases showed a balanced reciprocal translocation (10;13). His son had a partial trisomy 10 reported by Miró *et al.*⁸

The spermiogram showed severe oligozoospermia (table). At meiosis all stages of the cycle were found. All 37 diakinesis studied had a tetravalent in the form of an open chain resulting from failure of chiasma formation in one of the pairing regions of the translocation cross (fig 1).

CASE 2. 46,XY,t(5;7)(q13;q11)

This patient, aged 25, requested counselling because his wife had given birth to a malformed fetus at 8 months' gestation. Cytogenetic studies showed a balanced (5;7) reciprocal translocation.

The spermiogram showed oligoasthenoteratozoospermia. At meiosis, the number of divisions was low, but all 19 diakinesis studied had a tetravalent with the same configuration (fig 2) resulting from chiasma formation in all four pairing regions and one interstitial region.

Discussion

The number of meiotic studies in reciprocal translocation carriers is still low (table) and none of the published articles deals in depth with the genetic counselling implications of the meiotic figures observed, although Chandley *et al.*^{4,5,14} have repeatedly indicated that chain configurations carry a worse prognosis than rings, because of the fact that in such cases meiotic breakdown is more frequent.

Case 1 had a translocation involving band 10q25, which has recently been shown to be a fragile site, although it is only expressed by BrdU incorporation.^{15,16}

In Robertsonian fusions, counsellors may give a 33% theoretical risk or a 2 to 10% empirical risk depending on whether the carrier is the male or the female.¹⁷ However, as Moses *et al.*¹⁸ have shown in *Lemur* hybrids, this risk may be as low as 0% if pairing of the trivalent always takes place in the *cis* configuration, and higher than the theoretical 33% if pairing is in *trans*.

In reciprocal translocations, the theoretical risk is at least 50%, because adjacent segregation is probably as frequent as alternate segregation.¹⁹ However, in most published cases³⁻⁸ adjacent segregation has been the rule.

Finally, it must be taken into account that some types of translocation predispose to 3:1 disjunction.²⁰ These are the translocations involving an acrocentric, particularly a short one, and those with extreme disparity in total chromosome length. The behaviour of human reciprocal translocations has recently been reviewed by Jalbert *et al.*²¹

FIG 2 Diakineses and ring configurations in the carrier of a (5;7) translocation. Note terminal chiasmata close to interstitial chiasma (arrows).

Thus, the study of the meiotic behaviour of translocated chromosomes and of their pairing characteristics should be considered essential for counselling translocation carriers. Although it is not always easy to obtain gonadal material,^{5,12} the possibility of carrying out meiotic¹² and synaptonemal complex studies in the ejaculate²² enables investigations in all male carriers to be carried out.

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