Jpn. J. Human Genet. **36**, 117–129, 1991

A CYTOGENETIC SURVEY OF 14,835 CONSECUTIVE LIVEBORNS

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Summary The results of chromosome studies on cultured umbilical cord blood lymphocytes from a consecutive series of 14,835 liveborn infants (7,608 males and 7,227 females) are described. Ninety-three infants (6.27 per 1,000) had a major chromosome abnormality. Of these, thirty-one infants (2.09 per 1,000) had sex chromosome abnormalities. Seven male infants had a 47,XXY karyotype, five had a 47,XYY karyotype, and three were mosaics. One male had a ring Y chromosome in all cells examined. A pericentric inversion of the Y chromosome was found in one case. Seven female infants had a 47,XXX karyotype, one had a 45,X karyotype and six were mosaics. Sixty-two infants (4.18 per 1,000) had autosomal abnormalities. There were twenty-one infants with trisomy 21 including one mosaic, six infants with trisomy 18, and two infants with trisomy 13 of a Robertsonian translocation type. Three infants had an unbalanced derivative chromosome resulting from a parental reciprocal translocation. Two infants with a partial monosomy of chromosome 13 were detected. There were four infants carrying an additional small marker chromosome. Twenty-four infants (1.62 per 1,000) had a balanced structural rearrangement of the autosomes; eleven with a Robertsonian translocation, eleven with a reciprocal translocation, and two with a pericentric inversion. The incidence of each type of major chromosome abnormality in this study was quite similar to that obtained from previous newborn surveys.

Key Words chromosome abnormality, cytogenetic survey, newborn population

Received December 21, 1989; revised version received February 7, 1991; Accepted February 8, 1991.

INTRODUCTION

In 1978 we presented a preliminary report of a cytogenetic survey on 2,626 consecutive liveborn infants born during a period from December 1, 1975 to November 30, 1977 (Maeda *et al.*, 1978). The survey was continued until December 31, 1983 in the same manner, and for the following 3 years until December 31, 1986 using a G-banding method for chromosome analysis. In this report, we present the incidence and type of major chromosome abnormalities in 14,835 consecutive liveborn infants which were collected in one hospital during a period of 11 years and 1 month, and compare them with other livenorn surveys in the literature.

MATERIALS AND METHODS

Umbilical cord blood sampling, cell culture and chromosome analysis using conventional methods have been described previously (Maeda *et al.*, 1978). During the first part of the survey, five metaphase cells were analyzed for each individual. When any chromosome abnormality was found during analysis of conventionally stained preparations, special staining methods including Q-banding and/or G-banding were used to identify the abnormal chromosomes. Slides from each infant born during last 3 years of the survey were stained with Giemsa after treatment of trypsin. During the latter part of the survey, the chromosomes of two cells from each infant were counted and fully analyzed under microscopy. The number of analyzed metaphases was increased when mosaicism was suspected. When a balanced or an unbalanced structural rearrangement of the chromosomes was detected in an infant, blood samples were collected from both parents and their karyotypes were examined.

A total of 16,635 infants were born alive in the Kitasato University Hospital during a period from December 1, 1975 to December 31, 1986. Cytogenetic analyses were possible in 15,285 out of the 15,750 infants available for blood culture. During the period of investigation, 450 infants were born alive after prenatal karyotyping performed because of an increased risk of chromosomal aberration. The indications for prenatal karyotyping included advanced maternal age (320 cases), parental translocation (12 cases), previous child with Down's syndrome (30 cases) and miscellaneous (88 cases). Out of 12 pregnancies in which one parent had a known balanced translocation, 7 fetuses showed an identical translocation. All of these 450 infants were excluded from the study population in order to minimize possible selection bias.

The cytogenetic results obtained from a total of 14,835 infants consisting of 7,608 males and 7,227 females are presented. During the first period of investigation from 1975 to 1983, a total of 10,801 infants (5,512 males and 5,289 females) were studied, and 4,034 infants (2,096 males and 1,938 females) were karyotyped

Table 1. Anamnestic and clinical data of the study population (December 1, 1975 to December 31, 1986).

Total livebirths	16635
Blood samples obtained	15750
Unsuccessful cultures	465
Infants born after prenatal diagnosis	450
Infants successfully karyotyped [a]	14835
Males	7608
Females	7227
Sex ratio	1.05
Mean maternal age (years)	29.7±3.9
Mean gestational age (weeks)	38.4±1.8
Mean birth weight (g)	
Male	3002±442
Female	2909±421
Mean birth length (cm)	
Male	48.4±2.4
Female	47.8±2.4

[a] Infants with a prenatal diagnosis are excluded.

during the last 3 years from 1984 to 1986. Approximately three-quarters of the participating mothers (11,353 of 14,835 mothers) live in Kanagawa prefecture. During the study period, there were 1,052,880 live births in this area, thus 1.1% of these births were included in this survey. Some anamnestic and clinical data of the study population are listed in Table 1.

RESULTS

Of the 14,835 infants in whom a successful karyotype analysis was possible, 93 infants (6.27 per 1,000) had a major chromosome abnormality. Four infants with an additional minute chromosome were included in this total. We decided to consider a pericentric inversion of chromosome 9 as normal variant, and it is not included in the total of 93 major abnormalities.

1. Sex chromosome abnormalities in phenotypic males (Table 2)

Among the 7,608 male infants in whom a successful karyotype analysis was possible, 17 infants (2.23 per 1,000) had sex chromosome abnormalities. Seven (0.92 per 1,000) had a 47,XXY karyotype and five (0.66 per 1,000) had a 47,XYY karyotype. Three infants with mosaic sex chromosomes (46,XY/47,XXY, 46,XY/47,XYY, and 45,X/46,XY/47,XYY) were detected. Pericentric inversion of the Y chromosome was found in one case (356/76) and one infant (169/85) had a ring

Table 2. Male infants with sex chromosome abnormalities.

Newborn number	Karyotype	Parental age mother	father	Gestation (weeks)	Birth weight (g)	Birth length (cm)	Comments
163/79	47,XXY	25	25	40	2505	46.0	No physical abnormality
1118/80	47,XXY	33	33	39	3290	50.0	No physical abnormality
16/81	47,XXY	26	30	38	2565	46.3	No physical abnormality
897/82	47,XXY	33	37	38	3630	49.0	No physical abnormality
708/85	47,XXY	31	35	38	3440	49.5	No physical abnormality
1553/85	47,XXY	29	—	35	3003	48.6	No physical abnormality
1142/86	47,XXY	30	38	39	3152	48.0	No physical abnormality
1088/78	46,XY/47,XXY	23	33	40	3218	51.0	No physical abnormality
6/77	47,XYY	37	36	38	2682	48.0	No physical abnormality
203/77	47,XYY	40	37	36	2417	45.0	No physical abnormality
924/79	47,XYY	25	29	40	2410	48.0	No physical abnormality
272/82	47,XYY	35	35	39	3012	47.8	No physical abnormality
1431/86	47,XYY	26	—	39	2904	49.5	No physical abnormality
394/76	46,XY/47,XYY	29	29	38	2927	48.0	No physical abnormality
389/76	45,X/46,XY/47,XYY	32	35	38	2761	47.5	No physical abnormality, twin
356/76	46,X,inv(Y)	28	—	38	3265	49.7	No physical abnormality
169/85	46,X,r(Y)	29	—	38	2935	49.5	No physical abnormality

Y chromosome without mosaicism. In all infants no physical abnormality was found at the time of birth. The incidences of male infants with a sex chromosome abnormality during the two periods, 1975–1983 and 1984–1986, were 2.18 and 2.39 per 1,000, respectively (Table 7).

2. *Sex chromosome abnormalities in phenotypic females* (Table 3)

In the 7,227 female infants in whom a successful karyotype analysis was possible, 14 (1.94 per 1,000) had a sex chromosome abnormality. One infant with a 45,X chromosome complement (190/86) had evidence of intrauterine growth retardation and pedal lymphedema, and expired 2 days after birth. Seven infants (0.97 per 1,000) had a 47,XXX karyotype. Six infants were mosaics; one was 45,X/46,XX, one was 46,XX/47,XXX, one was 45,X/46,XY/47,XYY, two were 45,X/47,XXX and one was 45,X/46,X,idic(X)(q27). One of these infants with a 45,X/47,XXX karyotype (1008/80) had a webbed neck at the time of birth, while the remaining five infants showed no physical abnormality. Cases 388/76 and 389/76 (Table 2) were twins with an apparent opposite sex. The incidence of female infants with a sex chromosome abnormality during the first period (1.70 per 1,000)

Table 3. Female infants with sex chromosome abnormalities.

Newborn number	Karyotype	Parental age mother	father	Gestation (weeks)	Birth weight (g)	Birth length (cm)	Comments
190/86	45,X	38	—	38	2102	45.5	Died at 2 days of life
1415/76	45,X/46,XX	27	31	39	3130	47.0	No physical abnormality
327/76	45,X/47,XXX	28	37	38	2643	47.0	No physical abnormality
1008/80	45,X/47,XXX	24	29	38	2327	44.5	Webbed neck
388/76	45,X/46,XY/47,XYY	32	35	38	2761	48.0	No physical abnormality, twin
1253/85	45,X/46,X, idic(X)(q27)	24	—	38	3182	46.5	No physical abnormality
1224/76	47,XXX	25	25	39	2363	45.5	No physical abnormality
524/78	47,XXX	30	33	38	2715	45.0	No physical abnormality
1107/79	47,XXX	28	34	39	2470	45.0	No physical abnormality
192/80	47,XXX	39	42	38	3089	49.0	No physical abnormality
172/84	47,XXX	23	—	39	2040	45.0	No physical abnormality
1148/84	47,XXX	35	—	38	2520	46.5	No physical abnormality
965/86	47,XXX	29	—	37	2265	46.6	No physical abnormality
1263/82	46,XX/47,XXX	38	—	40	2830	48.0	No physical abnormality

and second period (2.58 per 1,000) was not significantly different (Table 7).

3. Autosomal trisomy (Table 4)

Twenty-one infants (1.42 per 1,000) had a karyotype with trisomy 21 including one mosaic (1031/83). The incidence of infants with trisomy 21 during the first period (1.48 per 1,000) was not different from that of the second period (1.24 per 1,000) (Table 8). All of the 21 infants had the clinical features of Down's syndrome. Six infants (0.40 per 1,000) with an additional chromosome 18 showed the clinical features of Edwards' syndrome and all died soon after birth. Three infants (0.20 per 1,000) had an additional small marker chromosome in all cells examined, and one was a 46,XY/47,XY,+mar mosaic. In these cases the origin of the marker chromosome was not identified.

4. Balanced structural rearrangements of autosomes (Table 5)

Twenty-four infants (1.62 per 1,000) had a balanced structural rearrangements of autosomes. Eleven (0.74 per 1,000) were a Robertsonian translocation, 11 (0.74 per 1,000) were a reciprocal translocation, and two (0.13 per 1,000) were a pericentric inversion. There was no significant difference between the incidences of balanced Robertsonian translocations during the first period (0.65 per 1,000) and the second period (0.99 per 1,000). The incidence of infants with a balanced reciprocal translocation was 0.74 per 1,000 in both the first and second periods. Nine of the 11

Table 4. Infants with an abnormal number of autosomes.

Newborn number	Karyotype	Parental age mother	father	Gestation (weeks)	Birth weight (g)	Birth length (cm)	Comments
316/77	47, XY, +21	27	27	39	2650	44.0	Down's syndrome
699/77	47, XX, +21	25	27	39	2147	45.5	Down's syndrome
1243/77	47, XX, +21	21	32	39	1945	45.0	Down's syndrome
391/78	47, XX, +21	35	—	38	3381	—	Down's syndrome
650/79	47, XX, +21	25	—	39	2487	46.0	Down's syndrome
792/79	47, XY, +21	30	—	38	3440	48.0	Down's syndrome
972/79	47, XY, +21	23	26	34	1500	40.0	Down's syndrome
475/80	47, XX, +21	35	37	38	2910	45.8	Down's syndrome
478/80	47, XY, +21	29	28	35	2500	46.0	Down's syndrome
38/81	47, XX, +21	27	—	37	2795	48.0	Down's syndrome
1071/81	47, XY, +21	36	—	38	3020	45.1	Down's syndrome
242/82	47, XX, +21	31	34	40	2881	47.5	Down's syndrome
577/82	47, XY, +21	31	—	38	3380	47.0	Down's syndrome
420/83	47, XY, +21	36	—	39	3551	49.5	Down's syndrome
1520/83	47, XY, +21	40	—	39	2875	45.5	Down's syndrome
661/84	47, XY, +21	28	30	28	1568	41.5	Down's syndrome, died at 56 days
1190/84	47, XY, +21	26	31	38	2282	46.0	Down's syndrome
1351/84	47, XY, +21	38	36	37	2231	44.2	Down's syndrome
397/85	47, XY, +21	35	37	39	3142	49.5	Down's syndrome
1454/85	47, XY, +21	35	42	37	2415	44.5	Down's syndrome
1031/83	46, XX/47, XX, +21	29	—	38	3316	49.5	Down's syndrome
1202/79	47, XX, +18	30	31	32	768	34.5	Edwards' syndrome, died at 3 days
522/80	47, XX, +18	26	28	40	1927	41.5	Edwards' syndrome, died at 10 days
555/80	47, XY, +18	31	35	37	1890	40.0	Edwards' syndrome, died at 4 days
1336/83	47, XX, +18	31	—	39	1960	42.0	Edwards' syndrome, died at 120 days
347/84	47, XX, +18	28	33	38	1906	41.5	Edwards' syndrome, died at 72 days
455/86	47, XY, +18	35	—	36	1152	37.5	Edwards' syndrome, died at 1 day
700/76	47, XY, +mar	38	—	37	3050	48.5	No physical abnormality
1032/83	47, XY, +mar	33	33	39	2739	50.0	No physical abnormality
947/86	47, XY, +mar	34	—	40	3356	49.0	No physical abnormality
345/84	46, XY/47, XY, +mar	34	38	38	3090	49.0	No physical abnormality

Robertsonian translocations identified were t(13q14q), one was t(14q22q), and the remaining one was t(21q22q). Nine of the 11 Robertsonian translocations were familial; seven were inherited from the mother, and two from the father. In one family (765/85), both the mother and father had a normal karyotype. In one

Table 5. Cytogenetic and clinical data from infants with a balanced structural rearrangement of autosomes.

Newborn number	Karyotype	Parental karyotype		Parental age		Gestation (weeks)	Birth weight (g)	Birth length (cm)
		mother	father	mother	father			
1034/76	45,XY,t(13q14q)	N	Ab	26	35	39	2900	49.0
1039/76	45,XY,t(13q14q)	Ab	N	31	33	38	2900	49.0
281/77	45,XX,t(13q14q)	Ab	N	26	30	39	2963	49.0
168/78	45,XX,t(13q14q)	Ab	N	28	29	37	2633	47.5
169/78	45,XX,t(13q14q)	Ab	N	28	29	37	2205	46.0
504/80	45,XX,t(13q14q)	N	Ab	26	—	39	3425	50.5
51/85	45,XY,t(13q14q)	—	—	32	—	38	2960	49.2
765/85	45,XY,t(13q14q)	N	N	28	—	39	2780	47.0
1251/85	45,XY,t(13q14q)	Ab	N	27	—	39	2446	45.0
1242/77	45,XX,t(14q22q)	Ab	N	26	28	39	3778	50.5
1324/85	45,XY,t(21q22q)	Ab	N	26	—	36	2343	45.8
209/78	46,XY,t(1;5)(p22;q33)	Ab	N	26	35	38	2860	48.0
812/79	46,XX,t(10;17)(q22;q25)	—	—	30	32	37	4131	51.0
180/80	46,XX,t(2;5)(q14;q14)	N	Ab	31	31	39	3139	48.5
327/80	46,XY,t(1;18)(q21;q21)	Ab	N	33	32	27	1110	—
1156/80	46,XX,t(Cp+;Dq-)	N	N	27	31	38	2757	46.0
503/81	46,XY,t(16;17)(p11;q12)	Ab	N	32	31	38	2800	47.5
809/82	46,XX,t(9;10)(q22;q25)	Ab	N	34	34	37	3191	48.5
79/83	46,XY,t(2;5)(q14;q14)	N	Ab	34	34	39	3369	49.8
505/84	46,XY,t(5;16)(q13;q24)	N	N	32	35	39	2815	48.0
143/85	46,XY,t(5;18)(q31;p11)	Ab	N	31	31	35	2067	42.5
173/86	46,XY,t(11;22)(q23;q11)	—	—	32	37	37	3031	48.2
1444/82	46,XX,inv(3)(p12;q25)	Ab	N	26	38	39	3504	50.7
804/83	46,XX,inv(2)(p23;q21)	N	Ab	38	—	39	3013	47.0

N, normal; Ab, abnormal.

family (51/85), the parents were not available for study. All of the 24 infants showed no physical abnormality at the time of birth. In one infant (505/84), a balanced reciprocal translocation found with the use of banding techniques might have easily been interpreted as normal without banding. Seven of the 11 reciprocal translocations were familial; five were inherited from the mother, and two from the father. Two cases (180/80 and 79/83) with a t(2;5) were siblings. In two families

(1156/80 and 505/84), both parents had a normal karyotype, and in two other families (812/79 and 173/86) blood samples were not available for study. In two cases with a pericentric inversion, one was inherited from the mother, and the other from the father.

5. Unbalanced structural rearrangements of autosomes (Tables 6A and 6B)

Seven infants (0.47 per 1,000) had an unbalanced structural rearrangement of autosomes. Of these, five infants (0.46 per 1,000) were detected during the first period, and two (0.50 per 1,000) were detected during the second period of the study. All seven infants died within one year after birth.

Case 346/76, with a 46,XX,−14,+t(13q14q) karyotype was born to a 28-year-old mother at 32 weeks of gestation. Her clinical features included microphthalmos, sloping forehead, cleft lip and palate, micrognathia, cyanosis, tachypea and retraction and hexadactyly of the left foot. She expired 12 hr after birth. Autopsy

Table 6A. Cytogenetic data from infants with an unbalanced structural rearrangement of the autosomes.

Newborn number	Karyotype	Parental karyotypes	
		mother	father
346/76	46,XX,-14,+t(13q14q)	46,XX	45,XY,t(13q14q)
1471/83	46,XX,-13,+t(13q13q)	—	—
468/84	46,XY,r(13)(p12q34)	—	—
605/78	46,XY,del(13)(q22)	46,XX	46,XY
51/79	46,XY,der(17),t(9;17)(p11;p13)	46,XX	46,XY,t(9;17)(p11;p13)
1066/84	46,XX,der(4),t(4;9)(p15;p13)	46,XX,t(4;9)(p15;p13)	46,XY
1163/79	46,XX,der(9),t(1;9)(q41;p24)	46,XX	46,XY,t(1;9)(q41;p24)

Table 6B. Clinical data of infants with an unbalanced structural rearrangement of the autosomes.

Newborn number	Parental age		Gestation (weeks)	Birth weight (g)	Birth length (cm)	Comments
	mother	father				
346/76	28	29	32	1280	—	Patau's syndrome, died at 12 hours
1471/83	31	34	38	3142	49.0	Patau's syndrome, died at 2 days
468/84	25	30	39	1450	33.0	Multiple congenital anomalies, died at 1 day
605/78	29	33	31	925	32.0	Multiple congenital anomalies, died at 1 day
51/79	26	28	38	1925	44.0	Multiple congenital anomalies, died at 8 months
1066/84	30	27	40	1588	40.0	Multiple congenital anomalies, died at 11 days
1163/79	27	24	38	2519	46.0	Multiple congenital anomalies, died at 8 months

revealed coarctation of the aorta, PDA, and polysplenia. A chromosome study of both parents revealed a normal karyotype in the mother, and 45,XY,−13,−14, +t(13q14q) carrier status in the father.

Case 1471/83, with a 46,XX,−13,+t(13q13q) karyotype, was born to a 31-year-old mother at 38 weeks of gestation. She had the clinical features associated with Patau's syndrome. The parents were not available for chromosome study.

Case 468/84, with a 46,XY,r(13) karyotype, was delivered by cesarean section at 39 weeks of gestation with a birthweight of 1,450 g. He was apneic and flaccid, and died 1 hr after birth. Anomalies included microcephaly, a broad nasal bridge,

Table 7. Comparison of sex chromosome abnormalities (rate/1000 in parentheses).

		Present study			7 surveys without banding[a]	3 surveys with banding[b]
		1975-1983	1984-1986	combined		
Total population		10801	4034	14835	54749	6753
Total males		5512	2096	7608	34379	3520
Total females		5289	1938	7227	20370	3233
Males	47,XXY	4 (0.73)	3 (1.43)	7 (0.92)	33 (0.96)	7 (1.99)
	47,XXY, mosaics	1 (0.18)	—	1 (0.13)	6 (0.17)	1 (0.28)
	47,XYY	4 (0.73)	1 (0.48)	5 (0.66)	28 (0.81)	7 (1.99)
	47,XYY, mosaics	2 (0.36)	—	2 (0.26)	7 (0.20)	—
	46,X,inv(Y)	1 (0.18)	—	1 (0.13)	9 (0.26)	3 (0.85)
	Others	—	1[c](0.48)	1[c](0.13)	3 (0.09)	—
	Total	12 (2.18)	5 (2.39)	17 (2.23)	86 (2.50)	18 (5.11)
Females	45,X	—	1 (0.52)	1 (0.14)	2 (0.10)	—
	45,X, mosaics	1 (0.19)	1 (0.52)	2 (0.28)	6 (0.29)	—
	47,XXX	4 (0.76)	3 (1.55)	7 (0.97)	20 (0.98)	3 (0.93)
	47,XXX, mosaics	3 (0.57)	—	3 (0.42)	4 (0.20)	—
	Others	1[d](0.19)	—	1[d](0.14)	—	—
	Total	9 (1.70)	5 (2.58)	14 (1.94)	32 (1.57)	3 (0.93)
Total sex chromosome abnormalities		21 (1.94)	10 (2.48)	31 (2.09)	118 (2.16)	21 (3.11)

[a] Nielsen *et al.* (1975), [b] Lin *et al.* (1976) 930 infants, Buckton *et al.* (1980) 3993 infants, Hansteen *et al.* (1982) 1830 infants, [c] 46,X,r(Y), [d] 45,X/46,XY/47,XYY.

hypertelorism, low set ears, micrognathia, macroglossia, a short webbed neck, an imperforate anus, an absent left thumb, hypospadias, cryptorchidism and talipes equinovarus. Autopsy findings included aplasia of the falx cerebri, agenesis of the corpus callosum, hypoplastic optic nerve, dilated fourth ventricle, ventricular septal defect and accessory spleens..

Case 605/78, with a 46,XY,del(13)(q22) karyotype was born to 29-year-old mother at 31 weeks of gestation. He weighed 925 g, and died 1 hr after birth. There was a partial defect of the cranium, meningo-encephalocele, cleft palate, low-set malformed ears, micrognathia, hypoplastic thumbs, imperforate anus, single flexion crease of the 5th fingers, syndactyly of 4th and 5th toes and overlapping of second toes onto the big toes. Autopsy revealed a PDA, hypoplastic polycystic kidneys and a hypoplastic gallbladder.

Table 8. Comparison of autosomal abnormalities (rate/1000 in parentheses).

	Present study			7 surveys without banding[a]	5 surveys with banding[b]
	1975-1983	1984-1986	combined		
Total population	10801	4034	14835	54749	14076
+13	—	—	—	3 (0.05)	—
+18	4 (0.37)	2 (0.50)	6 (0.40)	8 (0.15)	3 (0.21)
+21	16 (1.48)	5 (1.24)	21 (1.42)	63 (1.15)	18 (1.28)
+mar	2 (0.19)	1 (0.25)	3 (0.20)	12 (0.22)	5 (0.36)
+mar, mosaics	—	1 (0.25)	1 (0.07)	5 (0.09)	5 (0.36)
Deletions	1 (0.09)	1 (0.25)	2 (0.13)	5 (0.09)	—
Inversions	2 (0.19)	—	2 (0.13)	7 (0.13)	6 (0.43)
Robertsonian translocations					
balanced	7 (0.65)	4 (0.99)	11 (0.74)	52 (0.95)	13 (0.92)
unbalanced	2 (0.19)	—	2 (0.13)	2 (0.04)	—
Reciprocal translocations					
balanced	8 (0.74)	3 (0.74)	11 (0.74)	46 (0.84)	17 (1.21)
unbalanced	2 (0.19)	1 (0.25)	3 (0.20)	1 (0.02)	—
Y/Autosome translocations	—	—	—	6 (0.11)	1 (0.07)
Others	—	—	—	2 (0.04)	3[c] (0.21)
Total autosomal abnormalities	44 (4.07)	18 (4.46)	62 (4.18)	212 (3.87)	71 (5.04)

[a] Nielsen *et al.* (1975), [b] Lin *et al.* (1976) 930 infants, Buckton *et al.* (1980) 3993 infants, Hansteen *et al.* (1982) 1830 infants, Nielsen *et al.* (1982) 3658 infants, Bratkowska *et al.* (1985) 3665 infants,
[c] One with mosaic trisomy 8, two with duplication.

Case 51/79, with a 46,XY,der(17),t(9;17)(p11;q13) karyotype showed a characteristic phenotype of trisomy 9p, including brachycephaly, short neck, micrognathia, a protruding forehead, hypertelorism, a prominent large nose, short philtrum, downward slanted corners of the mouth, low-set malformed ears, club feet, short fingers, clinodactyly and a single flexion crease of 5th finger. Computed tomography of the head revealed slightly dilated ventricles. At the age of 8 months, he was readmitted because of cardiac insufficiency and expired at 255 days after birth. Autopsy revealed hypoplasia of tricuspid and mitral valves, and a PDA.

Case 1066/84, with a 46,XX,der(4),t(4;9)(p15;p13) karyotype had the following clinical features suggestive of trisomy 9p: hypertelorism, strabismus, antimongoloid slant of the palpebral fissures, a broad and prominent nasal bridge, globulous nose, downward slanted corners of the mouth, cleft lip and palate, large, low-set ears, clinodactyly, club feet and hypoplastic finger nails. She expired at 11 days after birth. Autopsy revealed an ASD, VSD, and coarctation of the aorta.

Case 1163/79, with a 46,XX,der(9),t(1;9)(q41;p24) karyotype had the following clinical features: hypertrichosis, hypotelorism, high arched palate, congenital glaucoma with corneal opacity, overlapping fingers and incurved 5th fingers. She expired at the age of 8 months because of bronchopneumonia.

DISCUSSION

Large scale of chromosome surveys of consecutive liveborn hospital births have been performed using conventionally stained preparations in seven different laboratories (Sergovich *et al.*, 1969; Gerald and Walzer, 1970; Lubs and Ruddle, 1970; Jacobs *et al.*, 1974; Bochkov *et al.*, 1974; Hamerton *et al.*, 1975; Nielsen and Sillesen, 1975). More recently, chromosome surveys of newborn infants utilizing various banding techniques have been published from 3 centers (Lin *et al.*, 1976; Hansteen *et al.*, 1982; Bratkowska *et al.*, 1985). Surveys with banding techniques were restarted in Edinburgh, Scotland (Buckton *et al.*, 1980) and Risskov, Denmark (Nielsen *et al.*, 1982). However, most of these surveys have been performed on largely Caucasian populations, and less was known about Japanese newborn populations. Higurashi *et al.* (1985) reported data on the birth prevalence of some kinds of chromosome abnormalities among 22,063 newnorn infants in Tokyo, but the initial screening method was somewhat different from that of the present study, as the cases were primarily selected on the basis of their own criteria, and not all infants were chromosomally analyzed.

The purposes of this study are to establish the incidence of major chromosome abnormalities among liveborn infants in Japan and to compare our data with those obtained from the previous surveys of primarily Caucasian infants. During the first period from 1975 to 1983, chromosome examinations were performed on 10,801 infants using an initial five-cell analysis of conventionally stained preparations. During the second period from 1984 to 1986, a total of 4,034 infants were chromosomally examined using an initial two-cell analysis of G-banded preparations.

In Table 7, the frequencies of sex chromosome abnormalities detected in this survey are presented separately, comparing the two periods together with the data obtained from the seven surveys reviewed by Nielsen and Sillesen (1975) and those summarized from three surveys in the literature in which banding analyses were routinely performed (Lin *et al.*, 1976; Buckton *et al.*, 1980; Hansteen *et al.*, 1982). The data for sex chromosome abnormalities from two surveys (Nielsen *et al.*, 1982; Bratkowska *et al.*, 1985) are not included in Table 7, since exact numbers of male and female infants were not given in their reports. Table 8 presents a comparison of the incidence of autosomal abnormalities in our survey, the seven previous surveys without banding, and the five surveys with banding. There was no significant difference in the incidence of any chromosome abnormality between the two periods of this survey. Whether the initial cytogenetic screening was performed on conventionally-stained preparations or on banded preparations, the incidences of major chromosome abnormalities appear to be quite similar.

The incidences of 47,XXY and 47,XYY male infants in this survey were quite close to the mean incidences obtained from seven previous surveys performed without banding. The unusually high frequencies of 47,XXY and 47,XYY male infants were noted in the pooled data from three surveys with banding, but no explanation for this high frequency was found. One female infant in our survey with a 45,X karyotype expired at 2 days of life. Only two such 45,X infants were detected among 20,370 females from the seven previous surveys performed without banding. The incidence of 47,XXX females found in this study was quite similar to that ontained from the previous seven surveys performed without banding and that obtained from three surveys with banding. There were eight infants with sex chromosome mosaicism among the first 10,801 infants, but only one among the second 4,034 infants, although the difference was not statistically significant. This may be explained by the difference in the number of cells analyzed during the two periods. The incidence of male infants with abnormal sex chromosomes in this survey was slightly higher than that of female infants. Similar trends were observed in pooled data from the previous seven surveys performed without banding, and those from three surveys with banding.

Balanced Robertsonian and reciprocal translocations occurred with equal frequencies in our series. This observation is in agreement with the previous seven surveys performed without banding. The mean incidence of balanced reciprocal translocations in the pooled data from the five surveys performed with banding was slightly higher than the incidence in this survey and in the seven surveys performed without banding. Although the difference is not significant, the reason for this comparatively higher incidence may be explained by the utilization of the new methods.

Finally, as four pregnancies were electively terminated during this study period after the prenatal detection of abnormal fetal karyotypes, the incidences of major chromosome abnormalities obtained in this survey must be considered to be minimal

estimates of frequencies in the population.

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