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Original Article

Analysis and clinical significance of chromosomal testing results for eugenics and genetic testing

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Abstract: Objective: To investigate the clinical significance of chromosomal testing for adverse pregnancy outcomes by studying the relationship between chromosomal test results of the eugenics and genetic testing and adverse pregnancy outcomes. Methods: A total of 2,831 couples with eugenics and genetic testing from January 2014 to December 2015 in our hospital were retrospectively analyzed and 218 couples with adverse pregnancy outcomes were selected as research subjects in this study. Chromosomal testing results and general information such as age and childbearing history of all the research subjects were collected and all the research data were statistically analyzed. Results: It was found that 218 out of 2831 couples who did eugenic examination gave abnormal birth, with a rate of 7.7%. It was also found that the age of the women when at pregnancy was higher than their normal counterparts.Thetermination of pregnancy ranked highest of the abnormal birth in the study, accounting for 54.59%, followed by fetal malformation and stillbirth. For the chromosomal analysis of the 218 couples who give imperfect births, 45 of them were diagnosed as unusual, with a rate of 10.32%. There was no such a case that both of two in a couple were chromosomal abnormal. The chromosomal abnormality rate of female (12.84%) was higher than that of male (7.80%) (P=0.001). The most common chromosomal abnormality was the balanced translocation (51.11%), which caused 60.87% of termination of pregnancy. The detectable rate of chromosomal abnormality in defective infants was the highest, followed by abortion and fetal malformation. Conclusion: Maternal chromosomal abnormality is more inclined to be detected in adverse pregnancy outcomes, and balanced translocation was the most common chromosomal abnormality in adverse pregnancy outcomes.

Keywords: Eugenics and genetic, chromosomal abnormality, fetal malformation

Introduction

Adverse pregnancy outcomes refer to the problems of the female during pregnancy, such as spontaneous abortion and stillbirth, or other problems like neonatal dysplasia, mental retardation, fetal malformation, etc. [1]. Both maternal and external circumstances are likely to lead to adverse pregnancy outcomes, among which, chromosome abnormality is one of the main reasons [2].

The number of defective infants (including fetal malformation, dysplasia, etc.) in China is increasing by about 900,000 cases per year [3]. Deformity, poor intelligence and dysplasia of these defective infants not only have serious impact on their families but also lower thecomprehensive quality of Chinese [4, 5]. Although chromosome detection is mature, its relevance to clinic practices stillremains to be seen [6]. Therefore, maternal eugenics and genetic testing have very important significance in comprehensive quality improvement for Chinese [7]. There were 218 couples appearing adverse pregnancy outcomes in 2,831 couples who consulted for the eugenics and genetic testing and they were retrospectively analyzed. It was reported as follows.

Materials and methods

General information

In total, 2,831 couples with eugenics and geneticstesting from January 2014 to December 2015 in our hospital were retrospectively analyzed and 218 couples with adverse pregnancy

Table 1. Analysis of general informationofeugenics andgenetic testers

Subject	Pregnant age	Gravidity	Parity
Couples with adverse pregnancy outcomes	28.49±2.93	3.89±0.34	1.38±0.19
Normal couples	25.39±3.02	3.02±0.17	1.41±0.31
Statistics	7.391	0.931	0.033
P	0.003	0.183	0.361

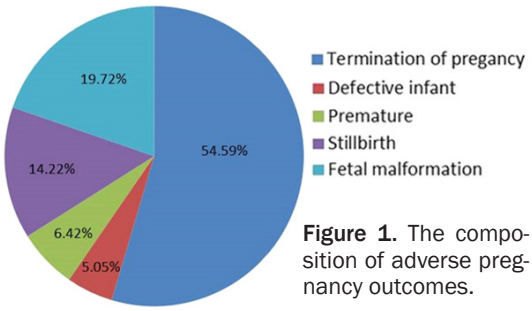

Figure 1. The composition of adverse pregnancy outcomes.

Table 2. Comparison of chromosomal abnormality of adverse pregnancy outcomes

Chromosomalabnormality	Male	Female
Case (n)	17	28
Percentage (%)	7.80	12.84
χ^2	9.529	
P	0.001	

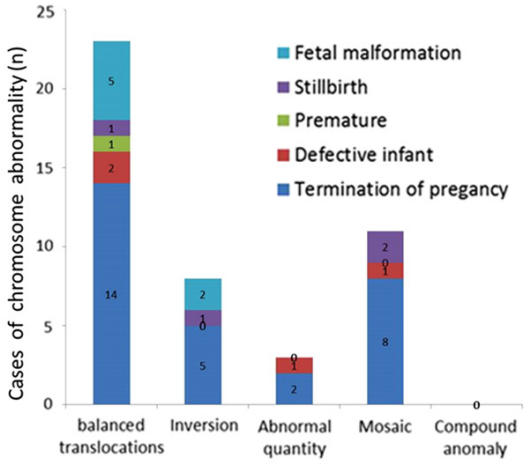

Figure 2. The relationship between the composition of chromosomal abnormality and adverse pregnancy outcomes.

outcomes were selected as research subjects of this study. Inclusion criteria: Who hadadverse pregnancy outcome history of premature infant, defective infant, abortion, fetal malformation, stillbirth, etc.; who didn't take contraceptive or exposed to strong ray before and after pregnancy; who did chromosomal testing and signed informed consent.

Research methods

Chromosomal testing results and general information such as age and childbearing history of all the research subjects were collected and all the research data were statistically analyzed.

Statistical methods

SPSS17.0 software was used for statistical analysis. Enumeration data was expressed by frequency and the comparison between couples with adverse pregnancy outcomes and normal couples were performed by chi square test. Measurement data was presented by mean and standard deviation and the comparisons between two groups were carried out by t test. When $P<0.05$, the difference reached statistical significance.

Results

The occurrence of adverse pregnancy outcomes

There were 218 couples appearing adverse pregnancy outcomes in 2,831 couples who consulted for the eugenics and genetic testing, with 7.7% of the incidence.

Comparison of general information between couples with adverse pregnancy outcomes and normal couples

It could be seen from the general information that the age of the women when at pregnancy was higher than their normal counterparts. (P=0.003), but there was nosignificant difference in gravidity and parity. See **Table 1**.

The composition of adverse pregnancy

The termination of pregnancy ranked highest of the abnormal birth in the study, accounting for

Table 3. Comparison of detectable rates of chromosomal abnormalities

Adverse pregnancy outcomes	Termination of pregnancy	Fetal malformation	Stillbirth	Premature infant	Defective infant
The total number of cases	119	43	31	14	11
Detectablerate(n, %)	29 (24.37)	7 (16.28)	4 (12.90)	1 (7.14)	4 (36.36)
χ^2			9.484		
P			0.004		

Table 4. The number of chromosomal abnormality detection(n)

	Adverse pregnancy outcomes	Normal pregnancy outcomes
Chromosomal abnormality	45	200
Chromosomal normality	173	2413

54.59%, followed by fetal deformity and stillbirth. See **Figure 1**.

Comparison of chromosomal abnormality of adverse pregnancy outcomes

For the chromosomal analysis of the 218 couples who give imperfect births, 45 of them were diagnosed as unusual. There is not a single case where both man and women have abnormal chromosomal arrangement. and there was no one detected out two or more chromosomal abnormalities in one subject, either.

The chromosomal abnormality rate of female (12.84%) was higher than that of male (7.80%) with statistically significant difference. See **Table 2**.

The relationship between the composition of chromosomal abnormality and adverse pregnancy outcomes

The most common of all chromosomal abnormalities was the balanced translocation (51.11%). There was 60.87% of termination of pregnancy caused by balanced translocation. See **Figure 2**.

Comparison of detectable rate of chromosomal abnormality

The detectable rate of chromosomal abnormality in defective infants was the highest, followed by abortion and fetal deformity, and that in premature infants was the lowest. See **Table 3**.

The number of chromosomal abnormality detection and its diagnostic accuracy

In total, there were 218 cases of adverse pregnancy outcomes and 2613 cases of normal pregnancy outcomes. For the chromosomal analysis of the 218 couples who give imperfect births, 45 of them were diagnosed as unusual, see **Table 4**. With 20.6% of sensitivity and 92.3% of specificity, its area under the curve was 0.793, which owned diagnostic value. See **Figure 3**.

Discussion

As the carrier of human DNA, chromosomes play a leading role in the human body and they are extremely essential [8]. Once chromosomal abnormality appears, it may lead to varioushereditary diseases [9, 10]. Therefore, if advance chromosomal testing andtimely intervention for couplescan be carried out, many cases of adverse pregnancy outcomewill be avoided [11]. The result in this study showed that 218 out of 2831 couples who did eugenic examination gave abnormal birth, with a rate of 7.7%. It was demonstrated that the incidence of chromosomal abnormalities in the general population was approximately 0.5% [12]. Nevertheless, the incidence in this study was obviously higher than that in above study, which may be because pregnant women who had family history of genetic diseases paid more attention to eugenics and genetic testing, and most of them consulted onthis aspect and did chromosomal testing [13-15]. It could be seen from the general information in this study that the males were older than the females. Itis associated with national conditions in China that the males are older than the females in the most of couples, but there is no direct correlation between age and adverse pregnancy outcomes [16-18].

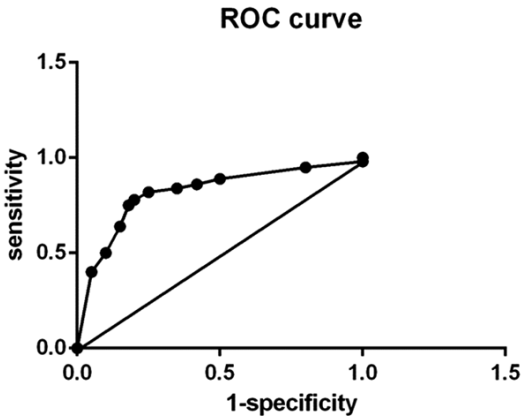

Figure 3. ROC curve of chromosomal abnormality detection.

Most of adverse pregnancy outcomes were termination of pregnancy in this study, accounting for 54.59%, followed by fetal malformation and stillbirth. In this study, 45 cases of chromosomal abnormalities were founded out in 218 couples, with a rate of 10.32%. There was no such a case that both of two in a couple were chromosomal abnormality. The chromosomal abnormality rate of female (12.84%) was higher than that of male (7.80%). The above results were similar to the findings of Fei et al., but the abnormality rate in this study was higher than that in their findings [19]. It was possible that the sample size in this study was so small that there was sample selection bias.

The most common chromosomal abnormality was the balanced translocation (51.11%). And there were 60.87% of termination of pregnancy caused by balanced translocation, followed by mosaic and inversion. However, Natesan found that the most cases of termination of pregnancy were caused by mosaic [20]. There may be regional differences, which can be further confirmed in future studies. Balanced translocationis a common type of chromosome structure abnormality, meaning that two or more than two chromosomes fracture and then they link together after exchanging their positions. Hence, the number and variety of genes never change; instead, two fragments exchange their positions. That is why the maternal and paternal generally have no clinical manifestation of chromosomal abnormalities, but there may be an obvious abnormality in embryo. The longer the translocation is, the greater the impact on the embryo is, especially for the time of embryo development, therefore, if there is a translocation, the pregnancy time will be affected most [21]. It can also be seen in this study, the mainly adverse pregnancy outcomes in balanced translocation is abortionand the longer translocation fragment may cause the abortion. The gene arrangement of inversion has changed, but the type of gene has not. So, there is normal phenotype for couples who are the inversion carriers. However, when the inverted chromosome is paired with a normal chromosome, the formed chromosome will be unbalanced, leading to gene deletion. Additionally, the longer the gene misses, the greater the change in phenotype is. That is why the probability of fetal malformationis higher when the inversion occurs, which is usually easy to be detected and pregnant women are suggested to be terminated the pregnancy during testing. The factors that affect chromosomal abnormalities also vary. On one hand, the maternal and paternal themselves are carriers of chromosomal abnormalities. On the other hand, if the maternal is affected by some external factors during pregnancy, such as drugs, radiation, and infection, it can also cause gene mutations in the embryo, resulting in chromosomal abnormalities, which can lead to abortion and fetal malformation further.

From the detectable rate, many congenital diseases can be detected by chromosomal testing. From the results in this study, the defective infants were most likely to be detected through chromosomal testing, followed by abortion andfetal malformation, but it was hard for the premature infants to be detected in the same way. Therefore, pregnant couples should be encouraged to carry out chromosomal testing so as to detect the adverse pregnancy outcomes early and terminate the pregnancy in time.

However, there were also some limitations in this study. Due to the low incidence of adverse pregnancy outcomes, only 45 couples with adverse pregnancy outcomes were studied, that was to say, small sample size. Therefore, we can increase the sample size in future studies and conduct in-depth study with large samples so as to obtain more scientific conclusions

To sum up, chromosomal abnormalities in female are more likely to cause adverse pregnancy outcomes, and balanced translocation is the

most common causes inchromosomal abnormalities, followed by fetal malformation and stillbirth. Therefore, chromosomal testing for eugenics and genetic consultants can effectively detect abortion, fetal malformationand other adverse pregnancy outcomes.

Disclosure of conflict of interest

None.

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