10.5005/jp-journals-10006-1597

GUEST EDITORIAL

# Antenatal Fetal Neurodevelopmental Assessment

**Toshiyuki Hata**

**Keywords:** Antenatal fetal neurodevelopmental test, developmental disorder, ethnic difference, Kurjak's antenatal neurodevelopmental test, psychotropic drug, sex difference.

**How to cite this article:** Hata T. Antenatal Fetal Neurodevelopmental Assessment. J South Asian Feder Obst Gynae 2018; 10(4):233-235.

**Source of support:** Nil

**Conflict of interest:** None

**Date of received:** 05-04-2018

**Date of acceptance:** 09-08-2018

**Date of publication:** March 2019

## INTRODUCTION

In childhood, the most frequent chronic motor disability is cerebral palsy (CP), with a global rate of 2–2.5 per 1,000 live-births and an unchanging incidence since 1951.[1] Based on current data, 60–70% of neurodevelopmental disabilities develop prenatally.[2] Moreover, a recent study demonstrated a sixfold increase in cesarean delivery without a change in CP prevalence over the past 50 years.[3]

Regarding autism spectrum disorders (ASD), the rate is increasing, with estimates of 0.15–1.2%.[4-6] Based on 2014 data, the estimated ASD prevalence was 2.24%, being significantly higher than an estimated annualized prevalence of 1.25% using 2011–2013 data from the USA.[7] Moreover, the prevalence of ASD in children with CP was 8.7%.[8] A comparative meta-analysis found that offspring born prematurely due to hypertensive disorders of pregnancy had a significantly higher rate of ASD than a matched control.[9] In the USA, the prevalence of all developmental disabilities considered collectively increased from 12.84–15.04% over 12 years from 1997 to 2008.[10]

Recently, epidemiologic evidence suggested that maternal infection was a risk factor for ASD and schizophrenia.[11] The link between maternal infection and neuropsychiatric disorders suggests that maternal immune activation (MIA) alone is sufficient to cause lifelong neuropathy and altered behaviors in offspring.

The main goal is to devise an antenatal fetal neurodevelopmental test that is able to identify impaired fetal brain and central nervous system (CNS) functions within the uterus, with the overall goal of such assessment being to effectively predict normal and abnormal fetal neurological developments post birth and improve outcomes of such patients.[12] Another purpose is to detect abnormal neurological findings *in utero* in children with developmental disorders including ASD diagnosed postnatally. In this Editorial, I would like to present my latest experiences regarding antenatal fetal neurodevelopmental test assessment.

### Kurjak's Antenatal Neurodevelopmental Test (KANET)

In 2008, Kurjak et al.[13] were the first to report a new scoring system KANET for fetal neurobehavior using four-dimensional (4D) ultrasound. The original KANET consists of 10 fetal behavioral parameters. In 2011, the new modified KANET test was proposed at the Osaka Consensus meeting, which uses eight instead of 10 parameters.[14]

### Ethnic Differences

We assessed ethnic differences in fetal behavior by comparing Asians and Caucasians.[15] The total KANET score for both was normal; however, a significant difference in total scores was revealed on comparing Japanese (median, 14; range, 10–16) and Croatian (median, 12; range, 10–15) ($p < 0.0001$) fetuses. On comparing individual KANET parameters, four fetal movements (isolated head anteflexion, isolated eye blinking, facial alteration or mouth opening and isolated leg movement) exhibited significant variation. However, there were no such differences in four other parameters (cranial suture and head circumference, isolated hand movement or hand-to-face movements, fingers movements, and gestalt of general movements). Based on these results, ethnicity is a factor to be considered when assessing fetal behavior, particularly fetal facial expressions.

### Sex Differences

Using the KANET test, we assessed sex differences in behavior between male and female fetuses.[16] The total

Professor and Chairman

Department of Perinatology and Gynecology, Kagawa University Graduate School of Medicine, Miki, Kagawa, Japan

**Corresponding Author:** Toshiyuki Hata, Professor and Chairman, Department of Perinatology and Gynecology, Kagawa University Graduate School of Medicine, Miki, Kagawa, Japan e-mail: toshi28@med.kagawa-u.ac.jp

KANET score for both groups was normal, with no significant difference. On comparing individual KANET parameters, there were no significant differences in any of the eight parameters, revealing the absence of a difference in male and female fetal behavior in the third trimester. Thus, fetal sex does not need to be considered in a 4D ultrasound study on fetal behavior.

### Effects of Psychotropic Drugs

In the third trimester, we used the KANET test to assess the effects of psychotropic drugs on fetal behavior.[17] The total score was normal (excluding one in the psychotropic-drug-administered group: total score of 9) in control and psychotropic-drug-administered groups, with no significant difference in the total KANET score on comparing the groups. Significant differences were not noted in any of the eight parameters on comparing individual ones. The results revealed the absence of difference in behavior between the fetuses of normal pregnant women and psychotropic-drug-administered pregnant women within the third trimester. Thus, psychotropic drugs may not influence fetal behavioral development in the uterus.

### Prediction of Postnatal Developmental Disabilities

The ability of the KANET to predict postnatal developmental disabilities was investigated.[12] There were 337 normal (95.47%) and 16 borderlines (4.53%) cases among 353 studied, with no abnormal case. Five cases of postnatal developmental disabilities (one of Werdig–Hoffmann diseases diagnosed directly after delivery, one of ASD diagnosed at age 24, one of Ullrich congenital muscular dystrophy diagnosed at age 9, and two of developmental disorders diagnosed at age 3 and 18 months, respectively) existed among 337 normal cases (1.48%), whereas three cases of developmental disabilities (one of motor development delay diagnosed at age 6, one of Duchenne muscular dystrophy diagnosed at age 18, and one of ASD diagnosed at age 30 months) were noted among the 16 borderline cases (18.75%). A significant difference in the rate of postnatal developmental disabilities was noted on comparing normal and borderline KANET groups ($p < 0.001$). Overall, KANET assessment may be effective to help predict postnatal developmental disabilities.

## CONCLUSION

The KANET may be an attractive antenatal fetal neurodevelopmental test to detect postnatal developmental disabilities in healthy fetuses *in utero*. Further studies involving a larger sample size are needed to confirm and validate this test for wide use in clinical practice.

## REFERENCES


1. Palmer FB. Strategies for the early diagnosis of cerebral palsy. J Pediatr 2004 Aug;145(2 Suppl):S8-S11.
2. Kurjak A, Stanojevic M, Andonotopo W, Salihagic-Kadic A, Carrera JM, Azumendi G. Behavioral pattern continuity from prenatal to postnatal life – a study by four-dimensional (4D) ultrasonography. J Perinata Med 2004 Jul;32(4): 346-353.
3. MacLennan AH, Thompson SC, Gecz J. Cerebral palsy: causes, pathways, and the role of genetic variants. Am J Obstet Gynecol 2015 Dec;213(6):779-788.
4. Rudra A, Belmonte MK, Soni PK, Banerjee S, Mukerji S, Chakrabarti B. Prevalence of autism spectrum disorder and autistic synptoms in a school-based cohort of children in Kolkata, India. Autism Res 2017 Oct;10(10):1597-1605.
5. Diallo FB, Fombonne É, Kisely S, Rochette L, Vasiliadis HM, Vanasse A, et al. Prevalence and Correlates of Autism Spectrum Disorders in Quebec: Prévalence et corrélats des troubles du spectre de l'autisme au Québec. The Canadian Journal of Psychiatry. 2018 Apr;63(4):231-239.
6. Raina SK, Chander V, Bhardwaj AK, Kumar D, Sharma S, Kashyap V, et al. Prevalence of autism spectrum disorder among rural, urban, and tribal children. J Neurosci Rural Pract 2017 Jul-Sep;8(3):368-374.
7. Zablotsky B, Black LI, Maenner MJ, Schieve LA, Blumberg SJ. Estimated prevalence of autism and other developmental disabilities following questionnaire changes in the 2014 national health interview survey. Natl Health Stst Report 2015 Nov 13;(87):1-20.
8. Delobel-Ayoub M, Klapouszczak D, van Bakel MME, Horridge K, Sigurdardottir S, Himmelmann K, et al. Prevalence and characteristics of autism spectrum disorders in children with cerebral palsy. Dev Med Child Neurol 2017 Jul;59(7): 738-742
9. Xu RT, Chang QX, Wang QQ, Zhang J, Xia LX, Zhong N, et al. Association between hypertensive disorders of pregnancy and risk of autism in offspring: a systematic review and meta-analysis of observational studies. Oncotarget 2018 Dec;9(1):1291-1301.
10. Boyle CA, Boulet S, Schieve LA, Cohen RA, Blumberg SJ, Yeargin-Allsopp M, et al.. Trends in the prevalence of developmental disabilities in US children, 1997-2008. Pediatrics 2011 Jun;127(6):1034-1042.
11. Estes ML, McAllister AK. Maternal immune activation: Implications for neuropsychiatric disorders. Science 2016 Aug;353(6301):772-777.
12. Hata T, Kanenishi K, Mori N, AboEllail MAM, Hanaoka U, Koyano K, et al.. Prediction of postnatal developmental disabilities using antenatal fetal neurodevelopmental test: KANET assessment. J Perinat Med 2018.
13. Kurjak A, Miskovic B, Stanojević M, Amiel-Tison C, Ahmed B, Azumendi G, et al. New scoring system for fetal neurobehavior assessed by three- and four-dimensional sonography. J Perinat Med 2008 Jan;36(1):73-81
14. Stanojević M, Talic A, Miskovic B, Vasilj O, Shaddad AN, Ahmed B, et al. An attempt to standardize Kurjak's

Antenatal Neurodevelopmental Test: Osaka consensus statement. Donald School J Ultrasound Obstet Gynecol 2011 Oct-Dec;5(4):317-329.

15. Hanaoka U, Hata T, Kanenishi K, AboEllail MAM, Uematsu R, Konishi Y, et al. Does ethnicity have an effect on fetal behavior? A comparison of Asian and Caucasian populations. J Perinat Med 2016 Mar;44(2):217-221.
16. Hata T, Hanaoka U, AboEllail MAM, Uematsu R, Noguchi J, Kusaka T, et al.. Is there a sex difference in fetal behavior? A comparison of KANET test between male and female fetuses. J Perinat Med 2016 Jul;44(5):585-588.
17. Hata T, Kanenishi K, AboEllail MAM, Mori N, Koyano K, Kato I, et al.. Effect of psychotropic drugs on fetal behavior in the third trimester of pregnancy. J Perinat Med 2018.