10.5005/jp-journals-10009-1313
REVIEW ARTICLE

Diagnostic Prenatal Invasive Procedures in Obstetrics

Giovanni Monni, Maria Angelica Zoppi, Ambra Iuculano

ABSTRACT

In 1977, we performed in Cagliari the first invasive prenatal diagnosis for beta-thalassemia in Europe, using fetal blood sampling by placentacentesis and chain globins analysis at 20th week of gestation. Since then we have performed more than 8,000 fetal diagnoses for beta-thalassemia using placentacentesis, fetoscopy, cordocentesis, cardiocentesis, amniocentesis, transcervical-chorionic villus sampling (TC-CVS), transabdominal (TA-CVS) and preimplantation genetic diagnosis (PGD) by embryo biopsy.

Since 1986 we have been using for the beta-thalassemia and other single gene diseases only TA-CVS and PGD and DNA polymerase chain reaction (PCR) analysis.

For karyotype we have been using mostly TA-CVS and amniocentesis and traditional cytogenetic analysis, in several cases also fluorescent in situ hybridization (FISH) and comparative genomic hybridization (CGH) array.

Keywords: Chorionic villus sampling, Amniocentesis, Cordocentesis, Preimplantation genetic diagnosis.

How to cite this article: Monni G, Zoppi MA, Iuculano A. Diagnostic Prenatal Invasive Procedures in Obstetrics. Donald School J Ultrasound Obstet Gynecol 2013;7(4):426-428.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

Prenatal invasive procedures for beta-thalassemia and chromosomal defects have been reported in Tables 1 and 2.

The most used invasive procedures in our department following nondirective genetic counseling were transabdominal chorionic villus sampling (TA-CVS), amniocentesis and fetal blood sampling (FBS) by cordocentesis and up to 2012 we have performed 56,000 prenatal diagnoses of which 8,000 for beta-thalassemia (Table 3) and the remaining for karyotype analysis and for other less common genetic diseases.[1,2]

The most common indications were: beta-thalassemia and DNA analysis, maternal age and first trimester screening for aneuploidies and congenital infectious diseases and in several cases preimplantation genetic diagnosis (PGD).

For beta-thalassemia and other Mendelian diseases when the genetic risk was higher we used TA-CVS and polymerase chain reaction (PCR) analysis.[3]

For karyotype analysis, after having considered the first trimester risk assessment by measuring the fetal nuchal translucency and biochemical test and when the cases were at higher risk, women preferred TA-CVS.[4,5] For advanced maternal age (≥ 35 years old) or following second trimester triple test we used TA-CVS in 35% of cases and amniocentesis in 55% of cases and in 10% we used FBS.[6]

The fetal nuchal translucency (Graph 1) and nasal bone screening is performed in our center for more than 55% of the Sardinian population with 6,500 tests per year and a total of 12,000 of newborns. Such first trimester risk assessment for aneuploidies and DNA analysis for Mendelian diseases changed dramatically the indication and the subsequent opting for TA-CVS in the first trimester.

Also, women well informed following first trimester risk assessment for chromosomal abnormalities preferred TA-CVS in cases at higher risk, considering the risk for fetal loss, sampling success similar to the risk after amniocentesis and the misdiagnosis acceptable (Table 4).

We always used freehand technique and tangential insertion to the ultrasound scanner of the spinal needle in the chorion, in amniotic cavity and in umbilical cord insertion.[7,8]

In women at age 35 years who have performed first trimester risk assessment and it resulted normal for aneuploidies, we have had in recent years a strong reduction in number of invasive prenatal procedures.[9-11]

Since 2004, we also performed PGD for Mendelian diseases using embryo biopsy aspiration and multiplex PCR analysis. In Italy, the law N° 40 in 2004 stopped this

Table 1: Changes in the approach for invasive prenatal diagnosis for beta-thalassemia in 6,547 cases at a single center from 1977 to 2004

	PC	*FS*	*CoC*	*CaC*	*AC*	*TC-CVS*	*TA-CVS*	*Total*	*PGD*
1977-1981	949 (100%)	0	0	0	0	0	0	949	0
1982-1985	32 (3.2%)	67 (6.7%)	120 (12.0%)	6 (0.6%)	203 (20.3%)	572 (57.2%)	0	1,000	0
1986-1993	0	0	0	0	0	0	2,011 (100%)	2,011	0
1994-1999	0	0	0	0	0	0	1,477 (100%)	1,477	0
2000-2004	0	0	0	0	0	0	1,110 (100%)	1,110	42
Total	981	67	120	6	203	572	4,598	6,547	42

PC: placentacentesis; FS: fetoscopy; CoC: cordocentesis; CaC: cardiocentesis; AC: amniocentesis; TA-CVS: transabdominal chorionic villi sampling; TC-CVS: transcervical chorionic villi sampling; PGD: perimplantation genetic diagnosis

Table 2: Changes in the approach for invasive prenatal diagnosis for karyotype analysis in 28,538 cases at a single center from 1977 to 2004

	AC	*TA-CVS*	*TC-CVS*	*CoC*	*HVS*	*Total*
1977-1981	404 (100%)	0	0	0	0	404
1982-1985	894 (63.49%)	0	142 (10.09%)	372 (26.42%)	0	1,408
1986-1993	5,125 (63.30%)	2,438 (30.11%)	0	516 (6.37%)	18 (0.22%)	8,097
1994-1999	5,662 (60.96%)	3,228 (34.75%)	0	387 (4.17%)	11 (0.12%)	9,288
2000-2004	5,780 (61.88%)	3,346 (35.82%)	0	213 (2.28%)	2 (0.02%)	9,341
Total	17,865	9,012	142	1,488	31	28,538

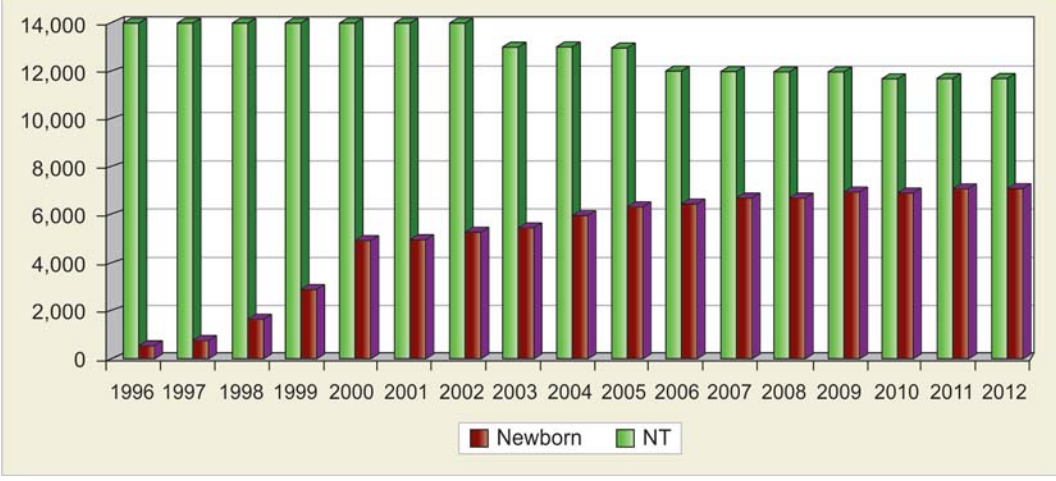
AC: amniocentesis; TA-CVS: transabdominal chorionic villi sampling; TC-CVS: transcervical chorionic villi sampling; CoC: cordocentesis; HVS: hepatic vein sampling

Table 3: Prenatal diagnosis of beta-thalassemia at Microcitemico Hospital, Cagliari from 1977 to 2012

Fetal blood sampling	1,174
Amniocentesis	201
Chorionic villus sampling	6,598
Preimplantation genetic diagnosis	42
Total	8,015

Table 4: 56,164 consecutive series in Cagliari center 1977-2012

	CVS	*Amniocentesis*	*FBS*
No	23,308	29,842	3,014
Fetal loss (%)	0.8	0.5	2.1
Misdiagnosis	2	2	2



Graph 1: First trimester screening for Down syndrome, Microcitemico Hospital, Cagliari: May 1996-December 2012—86,000 cases

procedure but in 2013 following several Court sentences we have started to perform again PGD.

By applying prenatal diagnosis for Mendelian diseases such as beta-thalassemia, in Sardinia, where 11 to 13% of the local population are carrier of the disease, the number of affected newborns is reduced dramatically, as well as newborns with trisomy 21 following first trimester fetal risk assessment of aneuploidies.[3]

REFERENCES

1. Cao A, Cossu P, Monni G, Rosatelli MC. Chorionic villus sampling and acceptance rate of prenatal diagnosis. Prenatal Diagn 1987 Sep;7(7):531-533.
2. Monni G, Ibba RM, Lai R, Cau G, Mura S, Olla G, Cao A. Transabdominal chorionic villus sampling: fetal loss rate in relation to maternal and gestational age. Prenat Diagn 1992;12(10):815-820.
3. Cao A, Rosatelli MC, Monni G, Galanello R. Screening for thalassemia: a model of success. Obstet Gynecol Clin North Am 2002 Jun;29(2):305-328, vi-vii.
4. Zoppi MA, Ibba RM, Floris M, Monni G. Fetal nuchal translucency screening in 12,495 pregnancies in Sardinia. Ultrasound Obstet Gynecol 2001 Dec;18(6):649-651.
5. Nicolaides KH, Chervenak FA, MCCullough L, Avgidou K, Papageorghiou A. Evidence-based obstetric ethics and informed decision-making by pregnant women about invasive diagnosis after first trimester assessment of risk for trisomy 21. Am J Obstet Gynecol 2005;193(2):322-326.
6. Monni G, Zoppi MA, Axiana C, Ibba RM. Changes in the approach for invasive prenatal diagnosis in 35,127 cases at a single center from 1977 to 2004. Fetal Diagn Ther 2006;21(4):348-354.

7. Monni G, Zoppi MA, Ibba RM. Prenatal genetic diagnosis through chorionic villus sampling. In Milunsky A, editor. Genetic disorders and the fetus: diagnosis, prevention, treatment. 6th ed. Baltimore: Wiley-Blackwell Publisher; 2009. p 160-193.
8. Monni G, Zoppi MA, Axiana C. Chorionic villus sampling. In: Winn HN, Chervenak FA, Romero R. Clinical maternal-fetal medicine. 2nd ed. London, England: CRC Press; 2011. p 62.1-10.
9. Ekelund CK, Jørgensen FS, Petersen OB, Sundberg K, Tabor A. Danish Fetal Medicine Research Group. Impact of a new national screening policy for Down's syndrome in Denmark: population based cohort study. BMJ 2008 Nov;337:a2547.
10. Morgan S, Delbarre A. Ward P. The impact of introducing a national policy for prenatal Down syndrome screening on the diagnostic invasive procedure rate in England. Ultrasound Obstet Gynecol 2013 May;41(5):526-529.
11. Monni G, Zoppi MA. Improved first-trimester aneuploidy risk assessment: an evolving challenge of training in invasive prenatal diagnosis. Ultrasound Obstet Gynecol 2013 May;41(5):486-488.

ABOUT THE AUTHORS

Giovanni Monni (Corresponding Author)

Director of Italian Branch, Ian Donald International University School of Medical Ultrasound, Department of Obstetrics and Gynecology Prenatal and Preimplantation Genetic Diagnosis, Fetal Therapy, Ospedale Microcitemico, Cagliari, Italy, Phone: 0039-70-6095546, 0039-336691120 Fax: 0039-70-6095514, e-mail: prenatalmonni@tiscali.it

Maria Angelica Zoppi

Gynecologist, Department of Obstetrics and Gynecology, Prenatal and Preimplantation Genetic Diagnosis, Fetal Therapy, Ospedale Microcitemico, Cagliari, Italy

Ambra Iuculano

Gynecologist, Department of Obstetrics and Gynecology, Prenatal and Preimplantation Genetic Diagnosis, Fetal Therapy, Ospedale Microcitemico, Cagliari, Italy