INFLUENCE OF MATERNAL PREGNANCY-INDUCED HYPERTENSIVE DISORDERS ON FETAL DEVELOPMENT AND GESTATIONAL AGE

Teofana Bizerea[1,2], Ramona Stroescu[1,2], Ana-Maria Nasarimba[1], Daniela Chiru[1,2], Tamara Marcovici[1,2], Constantin Ilie[1,3], Claudiu Angelescu[1,3], Otilia Mărginean[1,2]

Abstract

Pregnancy-induced hypertensive disorders (PIH) complicate up to 10% of all pregnancies and represent one of the leading causes of both maternal and fetal morbidity and mortality. Decreased blood flow to the placenta translates into chronic fetal hypoxia and fetal malnutrition, resulting in intrauterine growth restriction (IUGR), small for gestational age (SGA) newborns, prematurity, and even death. Aim of the study: The aim of the study was to determine the impact of maternal PIH on fetal growth and development by determining the prevalence of maternal PIH among newborns and identifying the incidence of preterm birth and SGA neonates born to mothers with PIH. Materials and methods: A retrospective observational study was conducted over a 3-year period (January 2014 -December 2016), at the Clinic of Obstetrics, Gynecology and Neonatology of the Emergency County Hospital Timisoara. Results and discussions: A total of 6108 newborns were included in the study. Patients were divided in 8 subgroups according to the presence or absence of maternal PIH (2 groups), term or premature birth (4 groups) and birth weight for gestational age (8 subgroups). From the total 6108 included newborns, 58 were born to mothers with PIH, representing an incidence of 0.94%. SGA criteria were met by 170 (2.7%) of the total patients and 289 (4.7%) patients were born preterm. The incidence of preterm birth was significantly higher among newborns with maternal PIH than mothers without PIH (62.1% and 4.2, respectively). SGA was more frequent in the preterm study groups compared to the term neonates [41.6% (preterm-PIH) and 24.5% (preterm) compared to 13.6% (term-PIH) and 1.5% (term)], and there was also a significantly higher prevalence of SGA in the term PIH group compared to term newborns without maternal PIH (13.6% compared to 1.5%). Conclusions: The prevalence of both premature birth and SGA was significantly higher in newborns with maternal PIH. Therefore, it can be concluded that maternal PIH exerts a negative effect on fetal growth and development. Intrauterine fetal monitoring of women with PIH and individual therapeutic managementof both mother and newborn are of paramount importance in improving the short and long-term outcome.

Keywords: abdominal ultrasound, screening, newborn, infant

Introduction

Pregnancy-induced hypertensive disorders (PIH), including preeclampsia and eclampsia, complicate up to 10% of all pregnancies and represent one of the leading causes of both maternal and fetal morbidity and mortality[1, 2].There are various risk factors predisposing women to PIH, including maternal age under 20 or over 35 years, nulliparity or multiple pregnancies, preexisting renal pathology, obesity, diabetes or immunological disorders, previous history of PIH, history of chronic hypertension, tobacco smoking, and alcohol and drug abuse[3-5]. A genetic substrate is shown by an increased incidence of PIH among patients with a positive family history [6]. PIH seems to be triggerd by an abnormal invasion of the cytotrophoblast by the spiral arteries, leading to reduced utero-placental perfusion [7-10]. Decreased blood flow to the placenta translates into chronic fetal hypoxia and fetal malnutrition, resulting in intrauterine growth restriction (IUGR), small for gestational age (SGA) newborns, prematurity, and even death [11-14]. The incidence of preterm birth and IUGR increases significantly due to maternal PIH [15].

Aim of the study

The aim of the study was to determine the impact of maternal PIH on fetal growth and development by determining the prevalence of maternal PIH among newborns and identifying the incidence of preterm birth and SGA neonates born to mothers with PIH.

Material and method

A retrospective observational study was conducted over a 3-year period (January 2014 -December 2016), at the Clinic of Obstetrics, Gynecology and Neonatology of the Emergency County Hospital Timisoara.

[1] "Victor Babeş" University of Medicine and Pharmacy Timişoara
[2] "Louis Ţurcanu" Emergency Hospital for Children Timişoara

E-mail: teofanabizerea@yahoo.com, ramona.giurascu@gmail.com, omarginean@ymail.com

The definition used for SGA was length and/or height less than two standard deviations (< -2SD) or third percentile (< Perc. 3%) below the mean for gestational age [16, 17]. Preterm birth is defined as alive birth that occurs prior to 37 weeks of gestation [18]. The cases of maternal PIH were determined from case-mix records using the RO DRG v1. classification system: code O13 (pregnancy induced hypertension), code O14 (preeclampsia), code O15.0 (eclampsia)[19].

An electronic registry composed of anonymized patient data was created by searching individual patient records. Inclusion criteria: inborn patients, age of 0-28 days. Exclusion criteria: women with pre-existing (chronic) hypertension, chronic renal disease, diabetes, cardiovascular disease, placenta previa, premature rupture of membranes and infections as well as newborns with documented infections, congenital malformations, and perinatal asphyxia.

A total of 6108 newborns were included in the study. Patients were divided in 8 subgroups according to the presence or absence of maternal PIH (2 groups), term or premature birth (4 groups) and birth weight for gestational age (8 subgroups).

Results

The mean and standard deviation for anthropometric parameters and APGAR score of the studied groups are shown in Table 1. Three of the four SGA neonate groups show difficulty of early neonatal adaptation, the most affected of which is that of Preterm SGA neonates with maternal PIH.

From the total 6108 included newborns, 58 were born to mothers with PIH, representing an incidence of 0.94% (Figure1). SGA criteria were met by 170 (2.7%) of the total patients (Figure 2), and 289 (4.7%) patients were born preterm (Figure 3).

As shown in Figure 4, the incidence of preterm birth was significantly higher among newborns with maternal PIH than mothers without PIH (62.1% and 4.2, respectively).

SGA was more frequent in the preterm study groups compared to the term neonates [41.6% (preterm-PIH) and 24.5% (preterm) compared to 13.6% (term-PIH) and 1.5% (term)], and there was also a significantly higher prevalence of SGA in the term PIH group compared to term newborns without maternal PIH (13.6% compared to 1.5%).

Group			n	Gestational Age	Birth Weight	Birth Length	Head Circumference at birth	APGAR score
No maternal PIH	Term	AGA	5707	38.9 ± 2	3342 ± 674	50.1 ± 3	34.1 ± 1.2	9.2 ± 1.7
		SGA	90	38.7 ± 1	2409 ± 146	47.9 ± 2	33 ± 1.25	8.85 ± 0.6
	Preterm	AGA	191	33.4 ± 3	2021 ± 567	45.5 ± 4	30.83 ± 2.69	7.12 ± 2.11
		SGA	62	34.2 ± 2.5	1878 ± 315.8	43 ± 4.75	30.1 ± 1.79	7.2 ± 1.20
maternal PIH	Term	AGA	19	38.4 ± 1.02	3326 ± 332	50.9 ± 1.73	34.7 ± 1.38	8.58 ± 0.84
		SGA	3	38.33 ± 0.57	2353 ± 66.5	47.67 ± 0.57	32.33 ± 0.57	7.66 ± 0.57
	Preterm	AGA	21	35.8 ± 1.3	2660 ± 517	48.2 ± 2	33.5 ± 1.4	8.1 ± 0.9
		SGA	15	34.27 ± 2.49	1785 ± 580	41.93 ± 3.35	30.36 ± 2.53	6.9 ± 1.16

AGA – appropriate for gestational age; SGA-small for gestational age; PIH-pregnancy induced hypertension

Table 1. Anthropometric characteristics and parameters of early neonatal adaptation of the studied groups

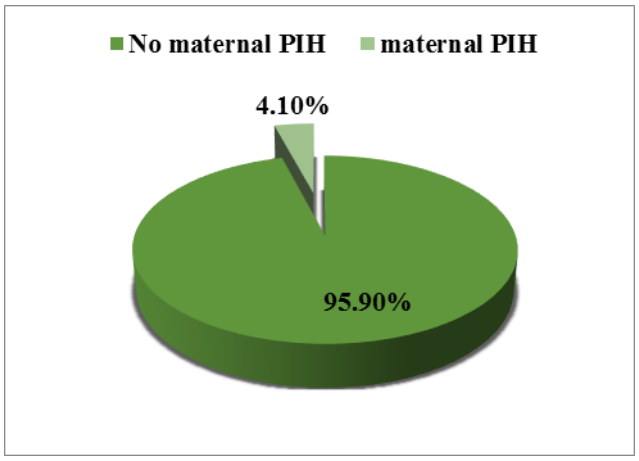

Fig.1. Incidence of maternal PIH among studied neonates

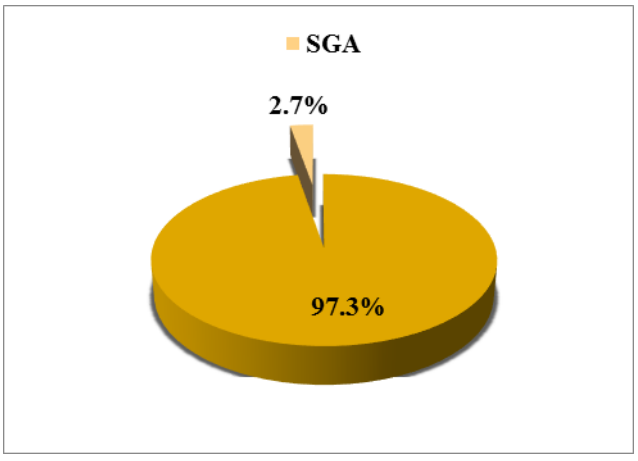

Fig. 2. Prevalence of SGA amid neonates included in the study

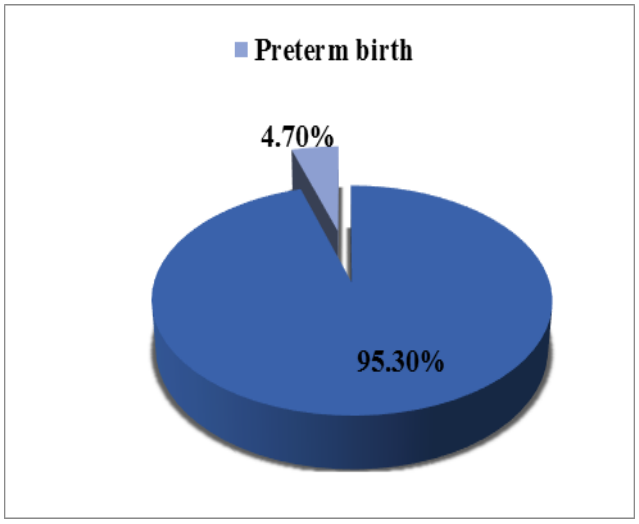

Fig.3. Prevalence of preterm birth from the total number of newborns

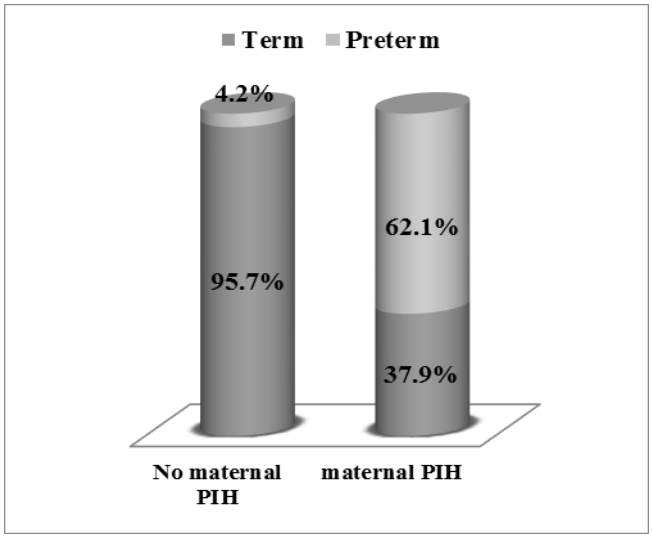

Fig.4. Percentage distribution of newborns by gestational age

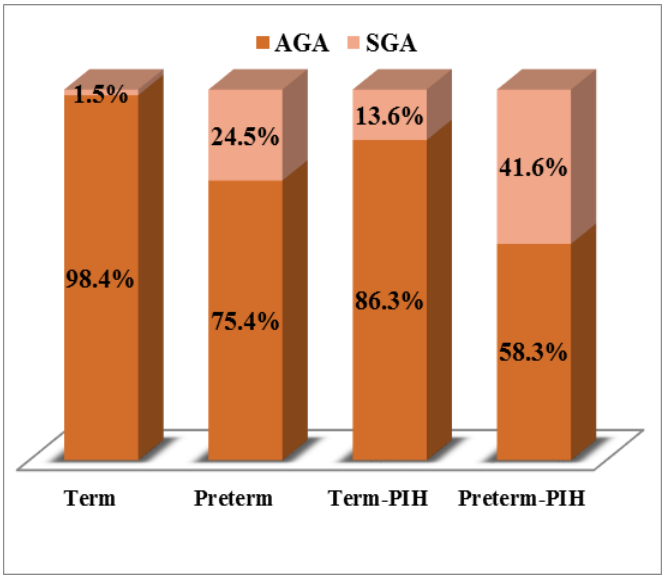

Fig.5. Percentage distribution of AGA and SGA newborns by gestational age and maternal PIH

Discussion

The incidence of PIH in this study was 0.94%, significantly lower than that quoted by literature. Various worldwide incidences have been reported for PIH. A study conducted by Muti, M., et al. shows an incidence as high as 19.4 % [20] whereas a report from the American College of Obstetricians and Gynecologists mentions a lower incidence of 10%[2], along with a study published by Sajith, M., et al. whose measured incidence is 7.8%[21].

Early neonatal adaptation was significantly more difficult for SGA neonates with maternal PIH. The increase of the mean APGAR score is correlated with a concurrent increase of gestational age and birth weight means. However, low APGAR scores can be noted in all of the studied groups of newborns with maternal PIH.

The prevalence of preterm birth was higher among newborns with maternal PIH and SGA was more frequent in all newborns with maternal PIH, which is consistent with previous literature [22, 23].

Conclusions

Abdominal ultrasound in the neonatal period and infancy is important in order to establish a complete diagnosis and subsequent monitoring. It can be extremely useful in the detection of serious birth defects or tumoral pathology in a subclinical phase, is non-invasive, affordable, with a low cost/efficiency ratio. However, it is time consuming, therefore its use remains at the discretion of each physician. A sonographic screening of asymptomatic patients may nonetheless be useful for specific indications in preselected individuals.

References

1. A Comprehensive Review of Hypertension in Pregnancy. Journal of Pregnancy, 2012. 2012: p. 19.
2. Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy. Obstet Gynecol, 2013. 122(5): p. 1122-31.
3. Parazzini, F., et al., Risk factors for pregnancy-induced hypertension in women at high risk for the condition. Italian Study of Aspirin in Pregnancy Group. Epidemiology, 1996. 7(3): p. 306-8.
4. Parazzini, F., et al., Maternal and paternal smoking and pregnancy-induced hypertension. Eur J Obstet Gynecol Reprod Biol, 2003. 109(2): p. 141-4.
5. Wong, T.Y., et al., Clinical risk factors for gestational hypertensive disorders in pregnant women at high risk for developing preeclampsia. Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health. 3(4): p. 248-253.
6. Lin, S., et al., Pre-eclampsia has an adverse impact on maternal and fetal health. Transl Res, 2015. 165(4): p. 449-63.
7. Gilbert, J.S., et al., Pathophysiology of hypertension during preeclampsia: linking placental ischemia with endothelial dysfunction. Am J Physiol Heart Circ Physiol, 2008. 294(2): p. H541-50.
8. Granger, J.P., et al., Pathophysiology of pregnancy-induced hypertension. Am J Hypertens, 2001. 14(6 Pt 2): p. 178s-185s.
9. Becerra, C.B., et al., Placental Hypoxia Developed During Preeclampsia Induces Telocytes Apoptosis in Chorionic Villi Affecting The Maternal-Fetus Metabolic Exchange. Current Stem Cell Research & Therapy, 2016. 11(5): p. 420-425.
10. Kingdom, J.C. and P. Kaufmann, Oxygen and placental villous development: origins of fetal hypoxia. Placenta, 1997. 18(8): p. 613-21; discussion 623-6.
11. Hampl, V. and V. Jakoubek, Regulation of fetoplacental vascular bed by hypoxia. Physiol Res, 2009. 58 Suppl 2: p. S87-93.
12. Hutter, D., J. Kingdom, and E. Jaeggi, Causes and mechanisms of intrauterine hypoxia and its impact on the fetal cardiovascular system: a review. Int J Pediatr, 2010. 2010: p. 401323.
13. Kadyrov, M., et al., Maternal-Placental Interactions and Fetal Programming. Zeitschrift Fur Geburtshilfe Und Neonatologie, 2013. 217(3): p. 88-94.
14. Irwinda, R., R. Surya, and L.F. Nembo, Impact of pregnancy-induced hypertension on fetal growth. Medical Journal of Indonesia, 2016. 25(2): p. 104.
15. Zhang, Z., et al., [Association of pregnancy-induced hypertension with small-for-gestational-age babies]. Zhonghua Liu Xing Bing Xue Za Zhi, 2008. 29(4): p. 313-6.
16. de Zegher, F., et al., Clinical review 89: Small as fetus and short as child: from endogenous to exogenous growth hormone. J Clin Endocrinol Metab, 1997. 82(7): p. 2021-6.
17. Niklasson, A., et al., An update of the Swedish reference standards for weight, length and head circumference at birth for given gestational age (1977-1981). Acta Paediatr Scand, 1991. 80(8-9): p. 756-62.
18. Institute of Medicine Committee on Understanding Premature, B. and O. Assuring Healthy, The National Academies Collection: Reports funded by National Institutes of Health, in Preterm Birth: Causes, Consequences, and Prevention, R.E. Behrman and A.S. Butler, Editors. 2007, National Academies Press (US). National Academy of Sciences.: Washington (DC).
19. Christensen, R.D., et al., Early-Onset Neutropenia in Small-for-Gestational-Age Infants. Pediatrics, 2015. 136(5): p. E1259-E1267.
20. Muti, M., et al., Prevalence of pregnancy induced hypertension and pregnancy outcomes among women seeking maternity services in Harare, Zimbabwe. BMC Cardiovascular Disorders, 2015. 15: p. 111.
21. Sajith, M., et al., Incidence of pregnancy induced hypertension and prescription pattern of antihypertensive drugs in pregnancy. Age (years), 2014. 23: p. 4.0.
22. Madan, J., et al., Maternal obesity, gestational hypertension, and preterm delivery. J Matern Fetal Neonatal Med, 2010. 23(1): p. 82-8.
23. Xiong, X., et al., Impact of Preeclampsia and Gestational Hypertension on Birth Weight by Gestational Age. American Journal of Epidemiology, 2002. 155(3): p. 203-209.

Correspondence to:

Teofana Otilia Bizerea
I. Nemoianu Street, no.2
Timisoara, Romania
e-mail: teofanabizerea@yahoo.com