

Corneal pachymetric particularities during hypertensive pregnancies. A clinical study

Abstract

While pregnant, a female patient may develop anterior pole pathology related to gestation, especially associated with gestational induced hypertension (GIH) or preeclampsia. We studied 26 female patients (19 to 41 years old) admitted in the Obstetrics-Gynecology Department from the Emergency University Hospital of Bucharest, with gestations ranging from 28 to 39 weeks, from which 15 patients had a form of GIH or preeclampsia. These patients were consulted in the Ophthalmology department and pachymetry measurements were documented. Our results showed that, as the gestation evolves, the cornea becomes thinner, as well as in normal pregnant women as well as in GIH ($p < 0.05$). Furthermore, there was a negative correlation between arterial diastolic blood pressure and corneal pachymeter values in GIH patients. Therefore, the anterior pole pathology in general and corneal thickness in particular, may become an important predictive factor for subtle, sometimes risky, ocular or retinal pathologic processes.

Keywords: cornea, pregnancy, preeclampsia, pachymetry, hypertension

Introduction

During pregnancy the female organism becomes subject to different morphologic changes, visible in multiple organ systems. In the eye, these changes may be divided in three subcategories: (i) physiologic, (ii) pathologic changes - central serous retinopathy, preeclampsia and eclampsia retinal dystrophies, exudative retinal detachment and cortical blindness, and (iii) pre-existing pathological changes that aggravate during pregnancy like diabetic retinopathy, meningioma or a pituitary tumour presence. In normal female individuals the intraocular pressure (IOP) decreases significantly during the last months of pregnancy and persists sufficient time during post-partum period. It has been supposed that an increased uveoscleral outflow due to hormonal changes specific to a gestation would facilitate the liquid drainage. Furthermore, glaucoma associated pathology seems to improve significantly during pregnancy⁽¹⁾. The purpose of this article is to bring attention to the pachymetric evaluation during pregnancies diagnosed with preeclampsia or gestational induced hypertension (GIH) in comparison with normal female patients, and their correlation with eventual blood pressure values elevation.

Methods

We have selected 26 female patients which have been studied between July 2016 and December 2016, admitted to the Obstetrics and Gynaecology Clinic and consulted in the Ophthalmology Section in the Emergency University Hospital of Bucharest, with prior ethical committee approval and patient consent. From these, a number of 15

were diagnosed with GIH while the other 11 were having normal blood pressure. The criteria for GIH diagnosis, in our study, implied a blood pressure over 140/90 mmHg, regardless of any presence of proteinuria. The exclusion criteria were: pre-existent pathologies (i.e. anterior pole trauma, glaucoma or surgical history). The ophthalmological evaluation consisted in assessing the following variables:

- (a) visual acuity assesement using Snellen® optotype;
- (b) specular biomicroscopy, that implies noncontact cornea endothelium examination using a Topcon specular microscope;
- (c) corneal topographic assesement that implied:
 1. Topographic map of anterior corneal aspect;
 2. Topographic map of posterior corneal aspect;
 3. Anterior and posterior corneal elevation map;
 4. Relative and absolute of absolute corneal thickness map, using a Oculus® Pentacam topograf;
- (d) posterior pole assesement using Zeiss® Visucam 500 and Keller® Professional ophthalmoscope, and not the least, corneal thickness evaluation due to pachymetry via a Alcon® Ocuscan RXP electronic technology.

Statistical analysis

Characteristics of the study subjects were expressed in $\text{med} \pm \text{SD}$ and percentage. Kendall rank correlation coefficient was used to examine the significance. Intuitively, the Kendall correlation between two variables will be high when observations have a similar (or identical for a correlation of 1) rank (i.e. relative position label of the observations within the variable: 1st, 2nd, 3rd etc.) between

**Vanessa Andrada Paun¹,
Liliana Voinea^{1,2},
Monica Cirstoiu³,
Alexandru Baros³,
Danut Vasile⁴**

1. Ophthalmology Clinic, Emergency University Hospital, Bucharest, Romania

2. Head of Chair of Ophthalmology Department, "Carol Davila" University of Medicine and Pharmacy, Emergency University Hospital, Bucharest, Romania

3. Clinic of Obstetrics and Gynecology, Emergency University Hospital, Bucharest, Professor of Obstetrics and Gynecology, "Carol Davila" University of Medicine and Pharmacy, Bucharest

4. 1st Clinic of General Surgery, Emergency University Hospital, Bucharest, General Surgery Senior Lecturer, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

Correspondence:
Dr. Vanessa Andrada Paun
e-mail: paunvanessa@gmail.com

Acknowledgements:
Special thanks goes to "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania, Emergency University Hospital of Bucharest - Obstetrics and Gynaecology, Ophthalmology Sections and their staff.

Received:
January 12, 2017

Revised:
February 03, 2017

Accepted:
February 10, 2017

en the two variables, and low when observations have a dissimilar (or fully different for a correlation of -1) rank between the two variables.

Results

The median age of the selected patients was of 30.962 years old, within an interval between 19 to 41 years old, with median gestational age 33.115 weeks, ranging between 28 and 39 weeks (Table 1).

Systolic blood pressure values recorded in these patients were in the interval of 120 to 180 mmHg, with a mean of 144.693 (± 16.9480) mmHg, while the mean diastolic pressure was of 85.179 mmHg (± 14.8171). The most frequent systolic pressure was that of 120 mmHg (16.2%), and 133 mmHg (10.8%) while those over 140 mmHg had an homogenous distribution (Table 2): 146 mmHg (7.9%), 148-150 mmHg (15.8%) and 170-175 (4.6%).

The most frequent diastolic interval meets the diagnostic criterion for preeclampsia: 90-120 mmHg (33.5%), followed by 80-89 mmHg (24.9%) and 70-79 mmHg (24.3%). It is observable that the tendency for systolic pressure remains towards extreme values, in older patients, while younger female patients have a median tendency. Isolate cases of elevated blood pressure that required medical attention (i.e. >140 mmHg) were recorded in older patients with overall age over 30 years old (Figure 1).

Ophthalmological anterior pole assement with pachimetric values identifies insignificant differences. Furt-

hermore, there was a negative corelation ($\Sigma < 0$) between blood pressure values and pachimetry parameters, thus, as much as the pressure rises, especially, diastolic, the corneal seem to become thinner (Tables 2 and 3), either due to increased IOP with more liquid production or corneal angle narrowing. It becomes observable that either in GIH patients or normal controls there are no unilaterality regarding corneal thickness, values being considerably similar in both eyes, thus, implying a systemic, generalized ethiopathogenic mechanism (Figures 2 and 3).

High blood pressure have a tendency to normalise as the gestation evolves, but there is no comparison criteria for such a result, as a larger study becomes mandatory for this consent.

In our analysis we may conclude that elevated blood pressure, in advanced pregnancies, and anterior pole pachimetry reveals a thinner cornea, in both eyes, with isolated higher values encountered in cases with other related ocular pathology.

Discussion

It has been hypothesized, that the increase of corneal thickness is corroborated with ankle and finger swelling, suggesting the existence of a relation between somatic hormonal changes, corneal thickness within a specific timing of characteristic pregnancy status. Thus, these ocular anterior pole changes are mainly, secondary to progesterone high-levels⁽²⁾.

Table 1 Descriptive statistic of entire study lot

	Range	Mean	Std.Dev	Minimum	Maximum
Age (years)	22	30.962	6.3213	19	41
Gestational age (weeks)	11	33.115	3.3980	28	39

Table 2 Arterial pressure descriptive statistic in the selected cases

	Range (mmHg) Min/Max		Median	Standard deviation
Systolic pressure	120	180	144.693	± 16.9480
Diastolic pressure	70	120	85.179	± 14.8171
systolic pressure(%)	120 mmHg (16.2%); 148-150 mmHg (15.8%); 133 mmHg (10.8%); 146 mmHg (7.9%); 170-175 (4.6%).			
Diastolic pressure (%)	90-120 mmHg (33.5%); 80-89 mmHg (24.9%); 70-79 mmHg (24.3%)			

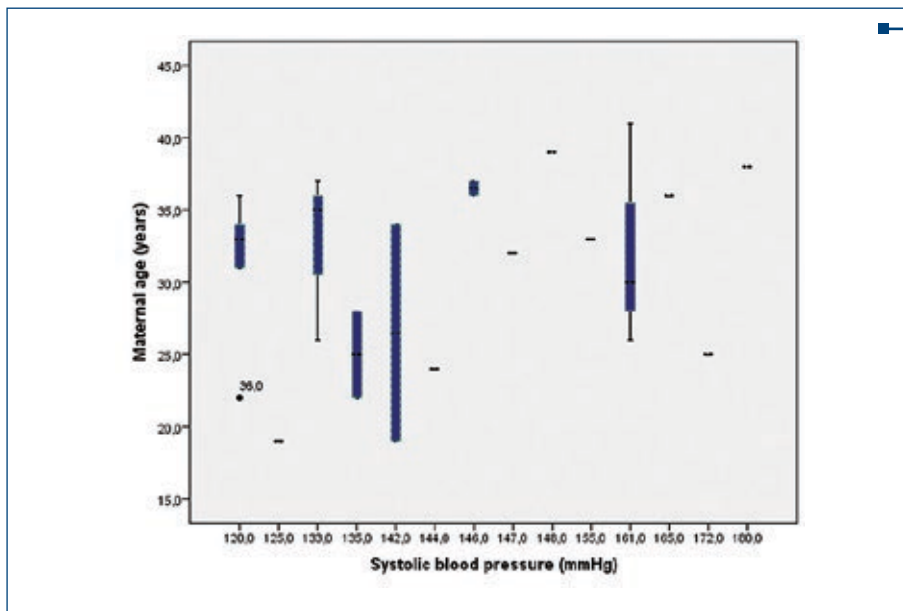


Figure 1. Systolic blood pressure distribution in accordance with maternal age of gestational female patients

Several studies report that the concentration of estrogen, progesterone and androgen increases in the corneal epithelial, stromal and endothelial cells.

The corneal stroma represents 90% of cornea thickness, being the most important contributor strata

to biomechanics. Extracellular corneal matrix consists of collagens, proteoglycans and this composition defines the corneal response to applanation forces during ocular tonometry. Thus, elevated progesterone, estradiol and prostaglandin levels would cause the

Table 3

Correlation Kendall's tau for pachimetry values for both eyes in correlation with gestational age and blood pressure (Cor - correlation coefficient; Σ - statistical value)

		Gestational age (weeks)	Right eye pachimetry (nm)	Left eye pachimetry (nm)	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	
Kendall's τ	Gestational Age (years)	Cor	-0.211	-0.147	-0.062	-0.068	
		Σ	0.143	0.307	0.672	0.640	
	Right eye Pachimetry (nm)	Cor	-0.211		0.675	-0.029	-0.083
		Σ	0.143		p<0.001	0.841	0.564
	Left eye Pachimetry (nm)	Cor	-0.147	0.675**		0.160	0.105
		Σ	0.307	p<0.001		0.267	0.465
	Systolic blood pressure (mmHg)	Cor	-0.062	-0.029	0.160		0.621
		Σ	0.672	0.841	0.267		p<0.001
	Diastolic blood pressure (mmHg)	Cor	-0.068	-0.083	0.105	0.621	
		Σ	0.640	0.564	0.465	p<0.001	

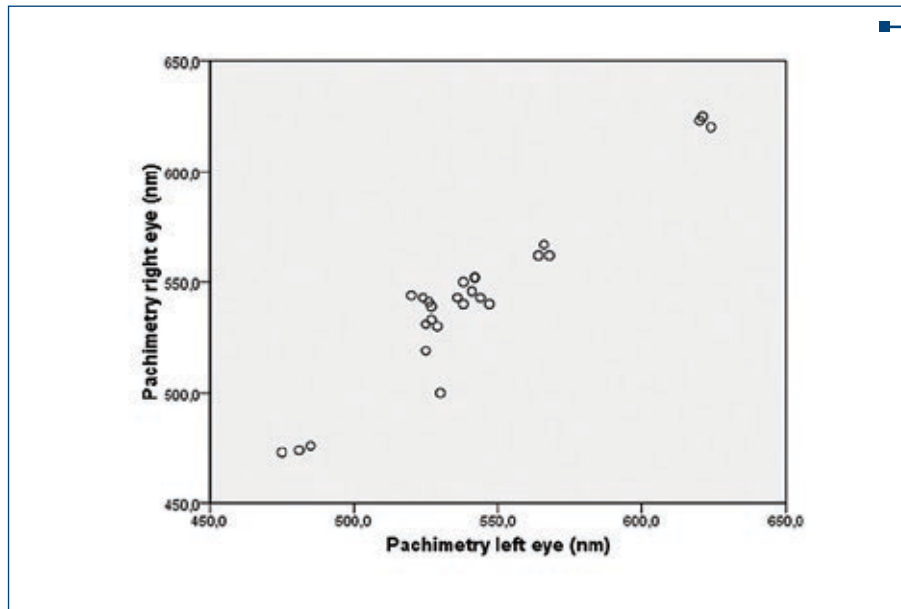


Figure 2. Interrelation between corneal thickness in both eyes for GIH and normal patients

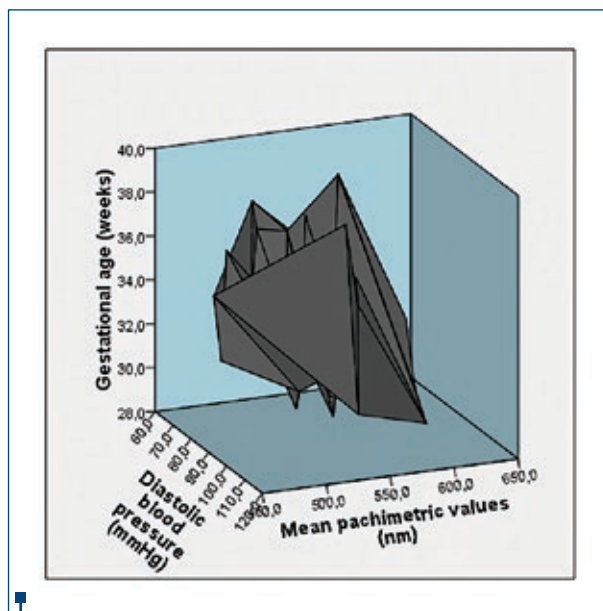


Figure 3. Stereoscopic correlation between mean pachymeter values, gestational age and diastolic blood pressure recorded in patients (mmHg)

activation of collagenases and of tissue inhibitor of metalloproteinase⁽³⁾.

Furthermore, it has been shown the ocular hypotensive effect of pregnancy, reported by different authors, with improvement of pre-existing pathology, like glaucoma was also documented in different studies.

Aqueous humour formation remains stable, while IOP decreases throughout the trimesters with a later return to normal values⁽⁴⁾.

Paradoxal thinning of cornea may appear due to a decrease in peripheral vascular resistance during pregnancy and is correlated with a lower IOP^(5,6).

It is generally accepted that third trimester corneal measurements are paradoxical due to corneal hydration, thus, with lower IOP. Hypertension seems to influence hormonal estrogenic levels, in reducing its values, together with progesterone levels. This implies a higher stiffness in cornea, with lower fluid retention and a thinner cornea. Also, corneal hysteresis and resistance factor vary significantly in GIH patients⁽⁷⁾.

Conclusions

Although GIH pregnant patients may have an obvious ocular pathology, the anterior pole seems to respond in a variety of possibilities to the systemic blood pressure elevation. There is little scientific data available for anterior pole modification during pregnancy, in general, and for GIH in particular, as most of these anomalies regress in post-partum period. However, the anterior pole morphology during gestation should not be overlooked as it is very dynamic and may reveal, in many cases, a subtle but dangerous retinal issue, due to close relation with an abnormal IOP and thus, possibly endangering visual perception for the mother. ■

References

1. Samra KA. The eye and visual system in pregnancy, what to expect? An in-depth review. Oman J Ophthalmol [Internet]. India: Medknow Publications & Media Pvt Ltd 2013, 6(2), 87-91.
2. Millodot M. The influence of pregnancy on the sensitivity of the cornea. Br J Ophthalmol 1977, 61(10), 646-9.
3. Sen E, Onaran Y, Nalcacioglu-Yuksekkaya P, Elgin U, Ozturk F. Corneal biomechanical parameters during pregnancy. Eur J Ophthalmol 2014, 24(3), 314-9.
4. Paterson GD, Miller sj. Hormonal influence in simple glaucoma. A preliminary report. Br J Ophthalmol 1963, 47, 129-37.
5. Wilke K. Episcleral venous pressure and pregnancy [proceedings]. Acta Ophthalmol Suppl 1975, (125), 40-1.
6. Weinreb RN, Lu A, Beeson C. Maternal corneal thickness during pregnancy. Am J Ophthalmol 1988,105(3), 258-60.
7. Spoerl E, Zubaty V, Raiskup-Wolf F, Pillunat LE. Oestrogen-induced changes in biomechanics in the cornea as a possible reason for keratectasia. Br J Ophthalmol 2007, 91(11), 1547-50.