



## Diagnostic Mydriasis: Any Effects on Systolic Blood Pressure?

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### Authors' contributions

*This work was carried out in collaboration among all authors. Author AKA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AKA, AOA and BF managed the analyses of the study. Authors AKA and CNPE managed the literature searches. All authors read and approved the final manuscript.*

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### ABSTRACT

**Aims:** To determine the effects of diagnostic mydriasis using 1% tropicamide and 2.5% phenylephrine on the systolic blood pressures of patients attending the Eye Clinic of University of Port Harcourt Teaching Hospital.

**Study Design:** Interventional comparative hospital based study.

**Place and Duration of Study:** Department of Ophthalmology, University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria, between November 2016 and January 2017.

**Methodology:** This was an interventional 'within-patient' comparative hospital-based study conducted over 3 months, in which the eyes of 137 subjects requiring pupillary dilatation for dilated fundus examination received 1% tropicamide and 2.5% phenylephrine. Systolic and diastolic blood pressures, pulse rates, pre and post dilation intraocular pressures (IOP), were amongst the parameters measured.

**Results:** There were 137 study participants - 86 males (62.8%) and 51 females (37.2%). The mean age of participants was 44.87±15.94 years. The highest proportion of participants had refractive errors - 53.3% and 54.0% in the right and left eyes respectively. There were slight reductions in systolic (122.54±16.89 mmHg to 122.51±20.88 mmHg) and diastolic (79.35±11.47 mmHg to

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78.12±12.62 mmHg) blood pressures. These differences in BP were however not statistically significant ( $p>0.05$ ). There was a statistically significant positive correlation between Systolic blood pressure and Post dilation IOP ( $p=0.0001$ ).

**Keywords:** Blood pressure; diagnostic mydriasis; intraocular pressure; tropicamide; phenylephrine; pulse rate.

## 1. INTRODUCTION

Diagnostic mydriasis involves the dilatation of the pupil to facilitate ophthalmological examinations, producing better diagnostic and therapeutic outcomes compared to the natural undilated pupil [1-3]. It is also used in the treatment of iritis by relieving pain caused by ciliary spasm and preventing the formation of posterior synechia [4]. In patients with cataract, pupillary dilatation aids proper preoperative assessment of the type, density, morphology and maturity of the cataract. It is also done preoperatively and its maintenance during surgery is important to facilitate uncomplicated cortex removal and intraocular lens insertion for cataract patients. Postoperatively, it helps to prevent synechia formation [5-7]. It is also done after glaucoma surgery to aid in deepening of the anterior chamber [8].

Ocular and systemic side effects associated with the use of tropicamide and phenylephrine either singly or in combination for pupillary dilatation have been documented in literature.

This study aims to add to the little data available on effects of diagnostic mydriasis on systolic blood pressure as seen in an African population.

## 2. MATERIALS AND METHODS

This was an interventional 'within-patient' comparative hospital-based study in which the eyes of 137 subjects requiring pupillary dilatation for dilated fundus examination received 1% tropicamide and 2.5% phenylephrine. Pre and post dilation blood pressures, pulse rates and intraocular pressures were amongst the parameters measured.

It was conducted over a three-month period lasting from November 2016 to January 2017. Data was analysed using the Statistical Package for Social Sciences (SPSS) version 20.0. A p-value of less than .05 was considered statistically significant.

Inclusion criteria was adult patients (aged 18 years and above) visiting the eye clinic of UPTH whose eyes required pupillary dilatation for dilated fundus examination (diagnostic mydriasis). Exclusion criteria included BP systolic  $\geq 140$  and/or diastolic  $\geq 90$  mmHg and Pulse Rate  $\geq 100$  beats per minute.

The details of research were made known to the subjects. Subsequently, their approval and signed informed consent was obtained before inclusion into the study. The approval of the Ethical Committee of the University of Port Harcourt Teaching Hospital to carry out this research was sought and obtained.

## 3. RESULTS AND DISCUSSION

The age and sex distribution of study participants were shown in Table 1. There were 78 (56.9%) males and 59 (43.1%) females with a male to female ratio of 1.32:1. The mean age of participants was 44.87±15.94 years (Range 19-83years). Majority of the participants were 41 years and above (87 out of 137). The sex distribution of the various age categories showed that there was an overall male preponderance. The differences in proportion of the age categories by sex of participants were statistically significant ( $p=0.0001$ ).

The frequency of ocular diagnosis in the right and left eyes of study participants were shown in Fig. 1. The highest proportion of participants had refractive errors (53.3% and 54.0% in the right and left eyes respectively). This was followed by cataract which was present in 32.0% and 28.9% of participant's right and left eyes respectively. Normal ocular findings were present in 11.7% and 14.6% of participant's right and left eyes respectively. Diabetic macular oedema occurred in 2.9% of participants right and left eyes.

The mean Changes in Blood Pressures and Pulse rates post dilatation (at 55minutes after dilatation) were shown in Table 2. The systolic blood pressure reduced slightly from 122.54±16.89 mmHg to 122.51±20.88 mmHg while the diastolic blood pressure reduced from

79.35±11.47 mmHg to 78.12±12.62 mmHg. The pulse rate also reduced slightly from 74.23±9.71 mmHg to 73.27±9.31 mmHg. These differences in blood pressures and pulse rates were however not statistically significant ( $p>0.05$ ).

The correlation between Systolic blood pressure and Post dilatation IOP in the right eye (RE) was shown in Fig. 2. There was a positive correlation between Systolic blood pressure and Post

dilatation IOP in the RE; as systolic blood pressure increases, post dilatation IOP increases. This was statistically significant ( $p=0.0001$ ).

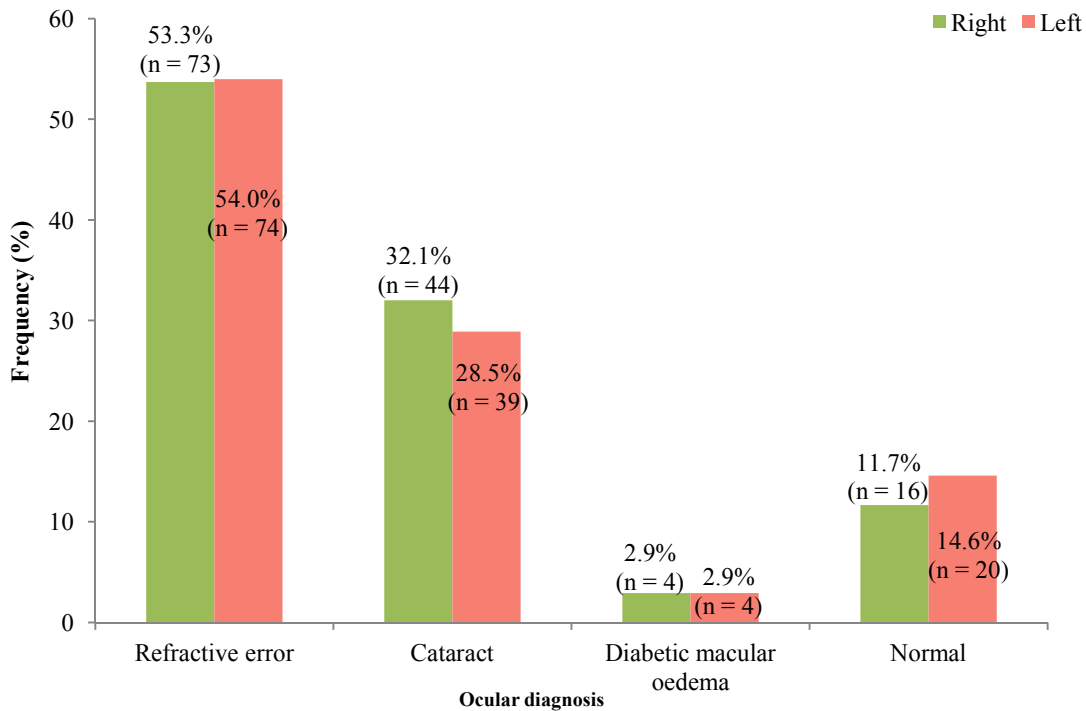
Multiple linear regression analysis showed that systolic blood pressure and pre dilatation IOP had a positive correlation with post dilatation IOP, with the regression equation shown above. This is shown in Table 3.

**Table 1. Age and sex distribution of study participants**

Age groups (years)	Sex		Total number (%)
	Male number (%)	Female number (%)	
≤20	0 (0.0)	8 (100.0)	8 (100.0)
21 – 30	19 (73.1)	7 (26.9)	26 (100.0)
31 – 40	11 (68.8)	5 (31.2)	16 (100.0)
41 – 50	20 (46.5)	23 (53.5)	43 (100.0)
51 – 60	20 (100.0)	0 (0.0)	20 (100.0)
61 – 70	8 (40.0)	12 (60.0)	20 (100.0)
>70	0 (0.0)	4 (100.0)	4 (100.0)
<b>Total</b>	<b>78 (56.9)</b>	<b>59 (43.1)</b>	<b>137 (100.0)</b>

Fisher's exact test = 36.713; p-value = 0.0001\*

\*statistically significant

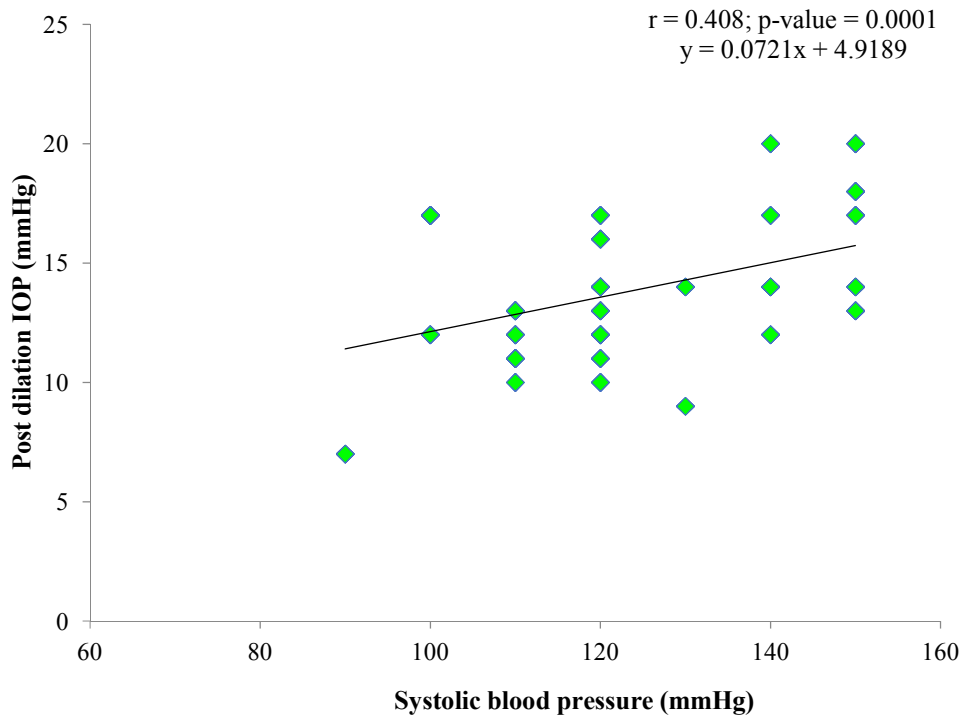


**Fig. 1. Ocular diagnosis of study participants**

**Table 2. Mean changes in blood pressures and pulse rates following dilatation**

Variables	Mean ± SD		Paired t-test	p-value
	Pre-instillation	Post-instillation		
Systolic BP (mmHg)	122.54±16.89	122.51±20.88	0.042	0.967
Diastolic BP (mmHg)	79.35±11.47	78.12±12.62	1.590	0.114
Pulse rate (bpm)	74.23±9.71	73.27±9.31	1.597	0.113

SD – Standard deviation



**Fig. 2. Correlation between systolic BP and Post dilation IOP of the RE**

**Table 3. Multiple linear regression analysis showing predictors of Post dilation IOP**

Variables	Coefficient B	95% CI		p-value
		Lower	Upper	
Systolic blood pressure	0.065	0.044	0.086	0.0001*
Pre-dilatation IOP	0.584	0.465	0.703	0.0001*
Constant	-1.417	-4.332	1.497	0.338

\*Statistically significant

Regression equation: Post-dilatation IOP = 0.065 (Systolic BP) + 0.584(Pre-dilatation IOP) – 1.417

### 3.1 Discussion

Pupillary dilatation for ophthalmological examinations to aid diagnosis (diagnostic mydriasis) is a very important aspect of ophthalmic practice. Diagnostic mydriasis has the ability to cause both ocular and systemic effects [9-15].

Using 137 study participants, this study focused on systemic side effects like changes in blood pressure and pulse rates and the relationship with intraocular pressure was also noted.

The mean age reported in this study is 44.87±15.94 years. The most common ocular diagnosis was refractive error which accounted

for the highest proportion. Refractive error was most commonly seen because, even though University of Port Harcourt Teaching Hospital is a tertiary Health Institution, it functions more as a Comprehensive Center so still sees all cases some of which ought to have been disposed off at the Primary or Secondary levels. Others were cataract and diabetic macular oedema.

Even though there was a slight reduction in the mean systolic and diastolic blood pressure and also in the pulse rate after 55 minutes of dilatation, it was not statistically significant. This is in agreement with studies done by some other researchers who found that blood pressure and heart rate were not significantly increased by the use of tropicamide and phenylephrine eyedrops either singly or combined. Fontanilla and Aguilar noted that the use of topical 2.5% phenylephrine was not associated with an increase in both blood pressure and heart rate [16]. Also, Mesina-Bayana and Arroyo found no significant effect of tropicamide / phenylephrine 0.5%/0.5% and tropicamide / phenylephrine 0.25%/1.25% on blood pressure and heart rate [17]. Other studies where no significant differences were noted [13,14].

On the other hand, some studies showed significant increase in blood pressures following dilatation. Van der Spek and Hantler in their study reported cases of increase in systolic and diastolic blood pressure, tachycardia and reflex bradycardia following the use of phenylephrine eyedrops and attributed these to the cardiovascular actions of phenylephrine which include vasoconstriction of the systemic, pulmonary and coronary arteries [13]. Fraunfelder and Scafidi in their study also reported cases of elevated blood pressure, tachycardia, reflex bradycardia, cardiac arrhythmias and subconjunctival haemorrhage following topical application of 10% phenylephrine.<sup>14</sup> Similarly, in a study by Kanawy and Jabir, a 10% rise in mean systolic blood pressure was noted 10-20 minutes after administration of 2.5% and 10% phenylephrine in two groups of patients prior to phacoemulsification [15]. This rise was noted in both groups. This difference between their findings and those of this study may not be unrelated to the concentration of phenylephrine used- 10% compared to 2.5% used in this study.

In this study, there was a positive correlation between Systolic blood pressure and Post dilation IOP i.e as Post dilatation IOP increased,

systolic blood pressure also increased. This was further buttressed by a multiple linear regression analysis which showed that systolic blood pressure and predilatation IOP had a positive correlation with post dilatation IOP. These could serve as good predictors for post dilation IOP.

#### 4. CONCLUSION

The results of this study may therefore imply that low concentrations of phenylephrine can safely be used for diagnostic mydriasis in normal patients and those with well-controlled hypertension. Predictors of a rise in post dilation intraocular pressure such as systolic blood pressure should be taken into cognizance in susceptible patients.

#### CONSENT

As per international standard or university standard written participant consent has been collected and preserved by the authors.

#### ETHICAL APPROVAL

The approval of the Ethical Committee of the University of Port Harcourt Teaching Hospital to carry out this research was sought and obtained.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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