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Blood Pressure Threshold for Abnormal Ocular Fundus Findings is Lower than Expected

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To the Editor

Ocular fundus examination is a critical part of the physical examination in patients with severely elevated blood pressure (BP), which is defined by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) as a BP exceeding 180/120 mmHg.¹ Indeed, the presence or absence of severe, grade III/IV, hypertensive retinopathy helps differentiate hypertensive emergencies requiring intensive care, from less severe hypertensive urgencies.¹ As a secondary analysis in the Fundus photography vs. Ophthalmoscopy Trial Outcomes in the Emergency Department (FOTO-ED) study,^{2,3} we sought to explore potential risk factors, in particular BP, for the presence of ocular fundus abnormalities relevant to the care of emergency department (ED) patients. We found evidence of acute end organ ocular damage at lower blood pressures than the JNC7 criteria.

350 adult patients presenting to the Emory University ED with a chief complaint of headache, acute focal neurologic deficit, visual changes, or a diastolic BP (DBP) \geq 120 were prospectively enrolled during the FOTO-ED study (ClinicalTrials.gov NCT00873613) from March 2009 and January 2010. Photographs of the ocular fundus (optic disc and macula) were obtained from both eyes using a commercially available nonmydriatic ocular fundus camera (Kowa α -D, Torrance, CA) by nurse practitioners on eligible patients between 7 AM and 10 PM, 7 days a week. Photographs were reviewed by neuro-ophthalmologists for ocular fundus abnormalities within 24 hours. Presenting complaints, triage systolic (SBP)

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and diastolic BP (i.e., on arrival to the ED), heart rate, body mass index (BMI), age, race, and gender were recorded and evaluated as risk factors for ocular fundus abnormalities. Univariate and logistic regression analyses were performed.

Forty-four patients (13.6%) in the FOTO-ED study had ocular fundus abnormalities relevant to ED care: 13 optic disc edema, 4 optic disc pallor, 4 retinal vascular occlusion, 13 isolated intraocular hemorrhages, and 10 grade III/IV hypertensive retinopathy.^{2,3} Exploratory univariate analyses using quintiles of SBP and DBP suggested that the risk of ocular fundus abnormalities increased markedly within the highest quintile of SBP (169 mmHg, 23% abnormal vs. 10%, $p=0.004$) and within the highest two quintiles of DBP (86 mmHg, 19% vs. 9%, $p=0.005$). To avoid collinearity, these criteria were combined and only patients with both SBP ≥ 170 mmHg and DBP ≥ 90 mmHg were considered to have elevated BP. Obesity (BMI ≥ 30) increased the risk of abnormalities (18% vs. 10%, $p=0.049$), as did a chief complaint of visual changes (23 vs. 9%, $p=0.0005$). Heart rate, age, race, and gender were not associated with ocular fundus abnormalities.

Controlling for obesity and visual complaints, the odds ratio of a ocular fundus abnormality among patients with both SBP ≥ 170 mmHg and DBP ≥ 90 mmHg was 4.2 (95%CI:1.87-9.43) compared to those with a lower BP. Excluding the 21 of 350 (6%) patients who were enrolled on the basis of a DBP ≥ 120 , this odds ratio was still significant: 2.8 (95%CI: 1.03-7.5, Table).

Seventeen of the 68 patients with elevated BP (25%) had fundus abnormalities. Seven of the seventeen (41%) with abnormalities were among patients enrolled for DBP ≥ 120 (all of whom met the JNC7 SBP criteria for hypertensive crisis/emergency). However, the remaining 10 patients (59%) with abnormalities had an elevated BP by the present study's definition (SBP ≥ 170 and DBP ≥ 90), but did not meet the JNC7 criteria. The ocular fundus findings among these 10 patients were 5 isolated intraocular hemorrhages, 2 grade III/IV hypertensive retinopathies (with BP 193/98 and 178/105), 1 anterior ischemic optic neuropathy, 1 branch retinal artery occlusion, and 1 optic neuritis.

We found that elevated BP (SBP ≥ 170 mmHg and DBP ≥ 90 mmHg) and obesity are risk factors for abnormal ocular fundus findings among patients presenting to the ED with headache or focal neurologic complaints. Notably, our BP threshold is substantially lower than that at which JNC7 proposes to examine patients for evidence of end organ damage suggestive of hypertensive emergency (i.e., $\geq 180/120$ mmHg). Among our patients meeting this less stringent BP threshold, 90% of the ocular findings (all except optic neuritis) can be clinically associated with elevated BP. Disturbingly, there were even two cases of malignant hypertensive retinopathy among them. This data suggests that the BP threshold proposed by JNC7 for severely elevated blood pressure is likely too high. Furthermore, examining the ocular fundus of patients with both SBP ≥ 170 mmHg and DBP ≥ 90 mmHg who also have headache or focal neurologic complaints is particularly appropriate.

Future study is necessary to externally validate these proposed lower BP thresholds, determine the applicability of these lower BP thresholds to patients who otherwise have no classic indication for ocular fundoscopic examination (e.g., no headache or focal neurologic complaint), and determine the relevance of the ocular fundus abnormalities seen in patients with elevated BP to long-term outcomes.

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Table

Multivariate logistic model for abnormal ocular fundus findings in 329 patients presenting to the emergency department with chief complaint of headache, acute focal neurologic deficit, or acute visual changes.

Variable	Odds ratio	95%CI	p-value
SBP 170 mmHg and DBP 90 mmHg	2.8	(1.03-7.5)	0.04
Obesity (BMI 30)	2.3	(1.1-4.8)	0.03
Acute visual chief complaint	5.1	(2.4-10.9)	<0.001

Intercept: -3.2, Hosmer-Lemeshow test, p=0.88, SBP=systolic blood pressure, DBP=diastolic blood pressure, BMI=body mass index