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# Carotid Endarterectomy Unexpectedly Resulted in Optimal Blood Pressure Control

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## ABSTRACT

*Resistant hypertension is defined as hypertension that remains above 140/90 mmHg despite the provision of three or more antihypertensive drugs in a rational combination at full doses and including a diuretic. It is associated with adverse clinical outcome and therefore requires aggressive medical treatment. We present a case of 70-year-old woman who was treated for resistant hypertension with a diuretic, ACE-inhibitor, calcium channel blocker, and with centrally acting antihypertensive, moxonidine. Despite of aggressive medical treatment her blood pressure remained above 160/90 mmHg continuously. Large diagnostic workup excluded common causes of secondary hypertension, but revealed significant carotid stenosis present on left internal carotid artery. Carotid endarterectomy was performed in order to improve cerebrovascular prognosis, but unexpectedly resulted in optimal control of her blood pressure. Two months after operation patient was on only one antihypertensive drug, having blood pressure below 130/85 mmHg. We suggest that in selected patients resistant hypertension could be associated with carotid stenosis and carotid sinus baroreceptor dysfunction. For definite conclusions further studies are warranted.*

**Key words:** carotid endarterectomy, hypertension, baroreceptors, antihypertensive agents

## Introduction

Hypertension is recognized as a major contributor to disease burden globally responsible for 7.6 million premature deaths worldwide<sup>1</sup>. Resistant hypertension is defined as hypertension that remains above 140/90 mmHg despite the provision of three or more antihypertensive drugs in a rational combination at full doses and always including a diuretic<sup>2</sup>. Higher obesity rates, older age, and increased use of certain exogenous substances are related to an increasing prevalence of resistant hypertension<sup>3</sup>. It has been suggested that resistant hypertension among patients with significant carotid stenosis should lead to investigation and management directed at the cause of hypertension<sup>4</sup>. We report an interesting case of patient with carotid stenosis and resistant hypertension in whom carotid endarterectomy unexpectedly resulted in optimal control of the blood pressure suggesting a role of carotid stenosis in pathophysiology of resistant hypertension.

## Case Presentation

A 70-year-old Caucasian woman presented in outpatient clinic complaining on frequent headache and nausea. Her physical examination among other was remarkable for a blood pressure of 190/100 mmHg measured repeatedly on right and left arm, both in supine and standing position. Heart auscultation revealed loud A2, with no heart murmur present. She denied any family history of hypertension or cardiovascular diseases. According to her medical documentation she was treated for one year time with different antihypertensive medications, but still having blood pressure above 160/90 mmHg continuously. Despite aggressive antihypertensive therapy blood pressure was still above normal values in repeated measurements. She denied non-compliance and took her medications on a daily basis in controlled environment. Biochemical evaluation revealed normal potassium levels, 4.0 mmol/L (normal range 3.5–5.2 mmol/L), normal aldosterone of 10 ng/dL (normal range 7–30



Fig. 1. Digital subtraction angiography (DSA) of the left carotid artery showing 85% stenosis of internal carotid artery.

ng/dL) and catecholamine levels of 55  $\mu\text{g}/24\text{h}$  (normal range  $<100 \mu\text{g}/24\text{h}$ ), and normal plasma renin of 1.1 ng AI/mL/h (normal range 0.2–1.6 AI/mL/h). Renal angiogram was normal, as well as renal ultrasound. Due to constant complains on headaches, CT scan of the brain was performed and showed signs of hypertensive encephalopathy (mild cerebral edema) as described by radiologist. Subsequently, carotid duplex ultrasound revealed atherosclerotic plaques in common carotid artery, external carotid artery, and internal carotid artery (ACI) on both sides, but significant stenosis of 85% was demonstrated only in the left ACI which was confirmed by digi-

tal subtraction angiography (DSA) (Figure 1). The patient underwent carotid endarterectomy (CEA) in order to reduce associated risk. The procedure was performed successfully and her postoperative course was uneventful. She was discharged home four days after surgery. Shortly after surgery her blood pressure dropped and she stopped taking drugs on her own. On repeated visits only ACE-inhibitor, ramipril (5 mg/day) was enough in order to keep her blood pressure below 130/85 mmHg.

## Discussion

Resistant hypertension as a specific subgroup remains unclear<sup>2</sup>. Secondary causes of hypertension are rather common in patients with resistant hypertension, although the overall prevalence is unknown<sup>2</sup>. They usually include sleep apnea, renal parenchymal disease, renal artery stenosis, and possibly primary aldosteronism. Uncommon secondary causes of hypertension include pheochromocytoma, Cushing's syndrome, hyperparathyroidism, aortic coarctation, and intracranial tumors<sup>2</sup>. In our case large diagnostic work-up did not reveal above mentioned causes, but showed significant stenosis on left internal carotid artery. Hypertension is very common in patients with carotid stenosis, and is recognized as important stroke risk factor<sup>4</sup>. Among patients with carotid stenosis there is high prevalence of resistant hypertension, usually caused by renovascular abnormalities<sup>4</sup>, and therefore optimal blood pressure control was not expected after CEA in this patient. Primary goal of CEA was to improve cerebrovascular prognosis<sup>5</sup>. According to the literature, acute hemodynamic instability can occur after CEA<sup>6</sup>. In the early postoperative period it can manifest either as hypotension or hypertension, but chronic effects are not very well known<sup>7</sup>. Some authors even suggest that carotid endarterectomy impairs blood pressure homeostasis through surgical destruction of the baroreflex mechanism resulting in a rise in mean arterial pressure<sup>8</sup>. In our case completely the opposite happened.

All things considered, we believe that there is indoubtable connection between carotid sinus and the blood pressure regulation. According to the published guidelines, investigation of carotid stenosis as a possible secondary cause of hypertension is not recommended, even though there is an increasing amount of research data which suggest that carotid atherosclerosis has an important role in pathophysiology of hypertension.

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## **KAROTIDNA ENDARTEREKTOMIJA NEOČEKIVANO REZULTIRALA OPTIMALNOM KONTROLOM TLAKA**

### **S A Ž E T A K**

Rezistentna hipertenzija definirana je kao povišeni krvni tlak iznad 140/90 mmHg unatoč liječenju sa tri ili više antihpertenziva u racionalnoj kombinaciji uz uključeni diuretik. Asocirana je sa nepovoljnom kliničkom prognozom i zahtjeva agresivno liječenje. Prezentiramo slučaj 70-godišnje bolesnice koja je liječena od rezistentne hipertenzije sa diuretikom, ACE-inhibitorom, blokatorom kalcijevih kanala uz centralno djelujući antihpertenziv, moksonidin. Unatoč agresivnom liječenju njezin je tlak bio kontinuirano iznad 160/90 mmHg. Opsežna dijagnostička obrada isključila je uobičajene uzroke sekundarne hipertenzije, ali je otkrila značajnu stenozu lijeve karotide. Učinjena je karotidna endarterektomija sa ciljem da se poboljša cerebrovaskularna prognoza bolesnice, a kao neočekivani postoperativni nalaz javila se normotenzija bolesnice. Na temelju kliničke opservacije sugeriramo da u selekcioniranih bolesnika rezistentna hipertenzija može biti asocirana sa stenozom karotide i disfunkcijom karotidnih baroreceptora. Za definitivne zaključke potrebne su kliničke studije.