

Relation between Blood Velocity Pattern and Vascular Endothelial Cell in the Renal Artery

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Abstract: Blood velocity pattern and structure of vascular endothelial cell was analyzed in aortorenal artery. At cranial side wall, where atheromatous plaque is prone to occur, blood velocity was characterized by oscillation and separation of the flow and low shear rate. Alignment of vascular endothelial cell was random and stress fiber was sparse. Blood flow may directly affect endothelial cell and change fine structure, and thus atheromatous plaque is localized.

INTRODUCTION

Atheromatous plaque is formed through long time and involves many complex process [1]. Atheromatous plaque is known to localize at bifurcation and curvature from pathological examination. At aorto-renal bifurcation atheromatous plaque is prone to occur at cranial side wall comparing to caudal or peripheral side walls [2]. We recently revealed the characteristics of blood velocity profile in the origin of the canine renal artery [3]. The purpose of this study was to further characterize the blood velocity in the renal artery in man and to analyze the structure of the vascular endothelial cell.

METHOD

We studied a total of 10 patients (7 men, 3 women) who were admitted to the Department of Urology, Kawasaki Medical School. Their clinical diagnoses were renal cancer (4 men, 3 women), retroperitoneal lymph node metastases of testicular cancer (2 men), and neuroblastoma (1 man).

Blood velocity profiles were measured with a high-frequency (20 MHz) pulsed Doppler velocimeter, which was developed in the Department of Medical Engineering, Kawasaki Medical School, in collaboration with Fujitsu Lab Co and has been described previously with detailed validation of the velocity patterns it measures [4].

The structure of vascular endothelial cell was observed by laser scanning confocal microscope. Wistar rats were anesthetized with ether and aortorenal artery was perfusion fixed. Cell nuclei and stress fiber were stained with bis-Benzimide and rhodamine phalloidine, respectively.

RESULTS

1. The flow on the cranial side of the renal branch of the human aortorenal bifurcation is characterized by (1) a bidirectional oscillation of the flow, (2) separation of the flow during systole, and (3) low time-averaged shear rate.
2. Comparing with caudal and peripheral side walls, at cranial side wall alignment of vascular endothelial cell was random and stress fiber was sparse.

DISCUSSION

In this study, we examined blood velocity pattern in the cranial side of the aortorenal artery and found the characteristic flow pattern. In addition we examined the fine structure of vascular endothelial cell in the same place. Thus, it is plausible that the local blood flow directly places the force on the vascular endothelial cell and changes the fine structure. The difference of fine structure may change the function of vascular endothelial cell. This may be a mechanism of localization of atherosclerosis.

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