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Investigation of Smooth Muscle Cells at the Junction of Renal Artery from Abdominal Aorta in Male Adult Dog

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Abstract: Aorto-branch junction always has been important as a site of arterial disease. We did this study because there were very little studies about smooth muscle cells at the aorta-branch junction. Renal arteries from six male adult dogs were examined in histological and ulterathin section. It was established that the orientation of smooth muscle cells at the junction of renal artery from abdominal aorta in dog was similar to the structure of muscular vein. There were two orientations of smooth muscle cells, circular form in tunica media and longitudinal form in the outer of tunica media and tunica adventitia. These orientations of smooth muscle cells probably have role in blood flow and control of affluence of blood to the renal artery.

Key words: Renal artery, bifurcation, smooth muscle cell, aorto-branch junction, histology, ultrastructure

INTRODUCTION

Aorto-branch junction always has been important as a site of arterial disease such as atherosclerosis. There are many reports about develop of vascular disease in aorto-branch junction. It has been reported that the structure of cerebral artery bifurcation in rat changes with increasing the age and it can be a major predisposing factor in the formation of cerebral artery aneurysm (Sheffield and Weller, 1980).

Carotid bifurcation and internal carotid artery have been known as a site for atherosclerosis (Mackinnon *et al*., 2004). In studies of the distribution of atheroma in aorta, it has been observed that it is most marked around the origin of the intercostals and lumbar arteries (Bell, 1935).

It has been reported that in the hypercholesterolemia rabbit, atherosclerotic lesions initially occur in the ascending aorta, thoracic aorta, especially at the distal and lateral sides of the orifices of dorsal intercostals arteries (Emura *et al*., 1992). It has been demonstrated that there are marked differences in the elastin pattern at aorto-branch junctions on the proximal and distal lips of the junctions, both for small elastic and large muscular branches arising from the abdominal aorta (Roach, 1986).

In the study of collagen fibers in brain arteries and bifurcation region it has been observed a narrow band of collagen along the apex of the flow divider that provides strength and stiffness in that region (Row *et al*., 2003). While we have good data on the collagen and elastic properties of aorto-branch junction there have been very little studies about smooth muscle cells at aorto-branch junction. So we decided to investigate the orientation of smooth muscle cells at the junction of renal artery from abdominal artery in male adult dog.

MATERIALS AND METHODS

Sex male dogs were used in this study: For light microscope study materials included 6 renal arteries from 3 dogs. The abdominal aorta and the adjoining right and left renal arteries were dissected out and stored in 4% formalin solution. After 48 h, the specimens were transferred in 10% formalin.

After dehydration through graded alcohols, the samples were cleared in xylol and embedded in paraffin so that serial longitudinal could be cut at 6 μm. The slides were then stained with Green Masson's Trichrom and smooth muscle cells at the junction of renal artery were investigated.

The materials for electron microscope study were taken immediately after slaughter from three dogs. The abdominal aorta and the adjoining right and left renal arteries were dissected out and the specimens from junction of renal artery from abdominal aorta were separated.

The specimens were fixed in glutaraldehyde and post fixed in OSO_4. The later treatment was carried out through bathing dehydration, adding propilenoxide and embedding in resin. Semithin sections were mounted on glass slides and stained with toluidine blue. Thin sections were stained with lead citrate and examined in electron microscope.

RESULTS AND DISCUSSION

It has been shown the orientation of smooth muscle cells at the junction of renal artery from abdominal aorta in Fig. 1-4. We observed two orientations of smooth muscle cells at the junction of renal artery, circular and longitudinal form. At the junction of renal artery, tunica media consisted of several layers of smooth muscle cells, which were commonly arranged in circular fashion with associate collagen and elastic networks. In outer tunica media and tunica adventitia, there were smooth muscle cells in the form of longitudinal (Fig. 1). Circular and longitudinal form of smooth muscle cells were also observed in electron another along a part of their length without their being any interposed patent connective tissue space (Fig. 4). This research showed that at the junction of renal artery from abdominal aorta in male adult dog, there were two microscopy. There were

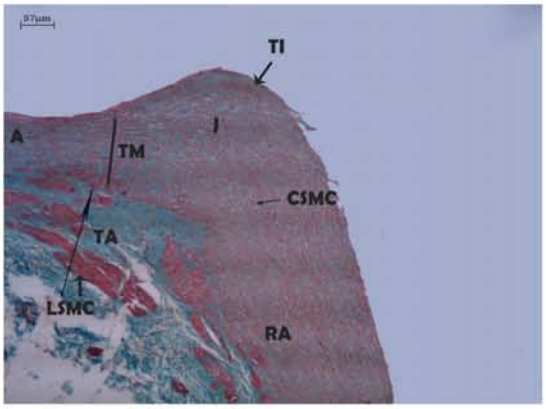

Fig. 1: Microscopic aspect of the junction of right renal artery in male adult dog (Green Masson's Trichrom×175). Tunica Intima (TI), Tunica Media (TM), Tunica Adventitia (TA), Aorta (A), Renal Artery (RA), Junction (J), Circular Smooth Muscle Cells (CSMC), Longitudinal Smooth Muscle Cells (LSMC)

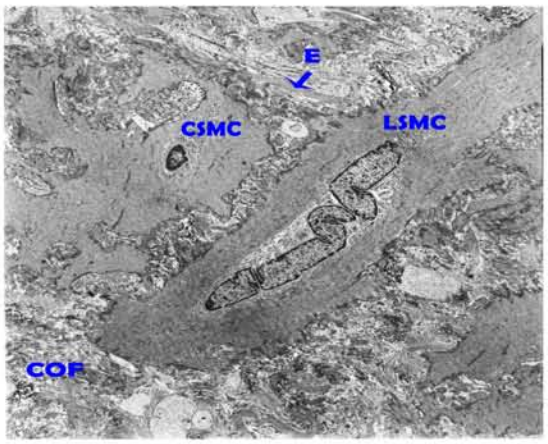

Fig. 2: Transmission electron micrographs of tunica media at the junction of right renal artery in male adult dog (×2200). (E): Elastin, (COF): Collagen Fibers, Circular Smooth Muscle Cells (CSMC), Longitudinal Smooth Muscle Cells (LSMC)

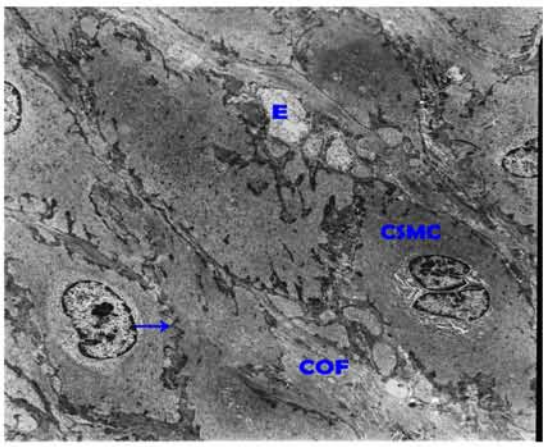

Fig. 3: Transmission electron micrographs of tunica media at the junction of right renal artery in male adult dog (×2890). (E): Elastin, (COF): Collagen Fibers, Circular Smooth Muscle Cells (CSMC). The smooth muscle cells adhere to each other along a part of their length (arrow)

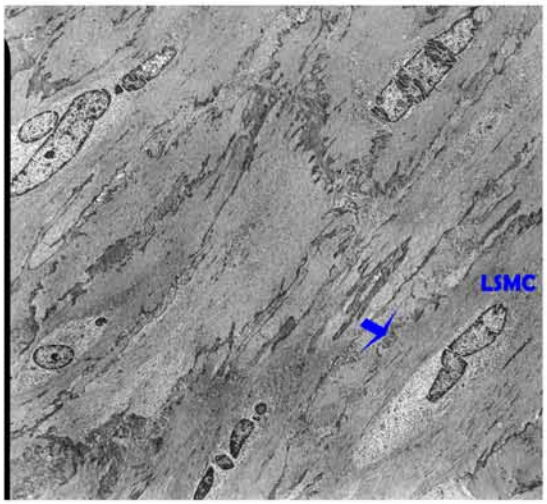

Fig. 4: Transmission electron micrographs of outer tunica media at the junction of right renal artery in male adult dog (×1650) Longitudinal Smooth Muscle Cells (LSMC). The smooth muscle cells adhere to each other along a part of their length (arrow)

collagen and elastic fibers between smooth muscle cells in exteracellular space (Fig. 2). Tunica media of the renal artery at the junction composed of smooth muscle cells in the form of circular. These cells were close to each other and adjacent smooth muscle cells occasionally adhered to another along a part of their length without their being any interposed patent connective tissue space. In some place was observed collagen and elastic fibers between smooth muscle cells (Fig. 3).

In the outer of tunica media longitudinally, oriented bundles of smooth muscle cells was seen that adjacent smooth muscle cells occasionally adhered to orientations of smooth muscle cells, circular form in tunica media and longitudinal form in the outer of tunica media and tunica adventitia. It has been reported that in the bifurcation pads (intimal pads) of hypertensive rats, smooth muscle cell damage first appeared in the roots of the pads. Thereafter, with a lapse in time after the operation, smooth muscle cell damage were arranged in the marginal zones (Kojimahara and Ooneda, 2008).

We know that during relaxation phase (diastole), elastic rebound of large arteries help to maintain arterial pressure and affluence of blood to the organ to be controlled by contraction or relaxing the smooth muscle cells of the tunica media (Junqueira *et al*., 2003). However, the fact that the orientations of smooth muscle cells at the junction of renal artery from abdominal aorta in dog are similar to the muscular vein is of special interest. The veins are dilatable when elastic and collagen fibers are more than smooth muscle cells in their wall and they are contractile if smooth muscle cells are more in their wall. The contractile state of the wall of vein plays an important role in blood flow (Fourman and Moffat, 1971). It has reported that the significance of bifurcation in the arterial walls is not clear but it is suggested that they may be mobile physiological structures for regulating blood flow (Kojimahara and Ooneda, 1980).

However, the observation of circular and longitudinal form of smooth muscle cells at the junction of renal artery gives reason to believe that they probably have role in blood flow and control of affluence of blood to the renal artery.

CONCLUSION

The results of this experiment demonstrated that at the junction of renal artery, tunica media consisted of several layers of smooth muscle cells, which are arranged in circular fashion and in outer tunica media and tunica adventitia there were smooth muscle cells in the form of longitudinal and they probably have role in blood flow and control of affluence of blood to the renal artery.

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