The Changes of Morphology of Human Renal Arteries with Age

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INTRODUCTION: Arterial function is determined by the microstructure and material composition of the arterial wall. The arterial wall is generally comprised of three layers: the intima, media, and adventitia. Two elastic lamellas are significantly existent in muscular arteries and strongly support the wall's structure. The internal elastic lamella (IEL) lies between the intima and media, and the external elastic lamella (EEL) between the media and adventitia. The structure of the arterial wall as a whole, as well as each layer, changes with increasing age, which leads to change in arterial function. The purpose of this study was to examine the morphology of the arterial wall for different ages to understand the age-related functional variations of arteries.

METHODS: Human renal arteries (age range of 2 to 86 years) were harvested during routine autopsy and stored at 4°C in L-15 transport solution. Arteries with obvious cardiovascular diseases were excluded. Specimens encompassed five age groups: 0~15, 16~30, 31~45, 46~60, and 60 years over. Loose surrounding tissue was removed and specimens were placed in a chemical fixative (4% formaldehyde 1% gluteraldehyde (4F1G)) for at least 24 hours to ensure complete fixation prior to further micro-structural analysis. All specimens were subjected to standard histology preparation: paraffin wax embedding, sectioning and staining. Histology slides were prepared for each specimen with the wall cross-section exposed. Elastin stain was used to differentiate layers of the arterial wall architecture following the procedure: deparrafinization and dehydration with xylene and alcohol, stain in Verhoeff's elastic stain working solution for 30 minutes, differentiation in 2% ferric chloride until sections appear grayish in color, counterstain with Van Gieson's solution for 2 minutes, and sequential dehydration in alcohol, ethanol and xylene. Tissues were examined under a microscope and digital images were made at several locations (at least 18) for each specimen. Thickness of each layer was recorded and expressed as mean ± standard deviation. Differences between age groups were assessed with the Student t test, and $p<0.05$ was chosen as the level of significance.

RESULTS AND DISCUSSION: The IEL was thicker than EEL throughout all age groups (Figure 1). The IEL thickened slightly up to 45 years old; afterward the thickening stopped, which is consistent with the study of Hegedus et al [1]. In contrast, the thickness of the EEL was almost constant up to 45 years old and increased slightly in the older groups. The thickening of the intima was remarkably with age, especially after the 6th decade. Vancov et al [2] also found that after 40-year, the intima thickened pronouncedly. Compared with the media and adventitia, the thickness of the intima was negligible (Figure 2). The thickness of the media increased with age up to 45 years and then remained stable. Because the loose surrounding tissue was removed, only part of the adventitia was present and its thickness was greatly dependant on how much tissue was removed. Therefore, the thickness measurements of the adventitia were not reliable. The arterial wall's thickness as a whole indicating the contribution of individual components, the intima, IEL, media, and EEL, is shown in Figure 3. Adventitia was excluded. The overall thickness of the wall increased with age until the middle of the 5th decade and stayed almost constant after then. Even though after 45 years old, the intima became more significant in the arterial wall and its thickness increased, the media in the older age groups was still the predominance of the wall thickness. The total thickness of the arterial wall (without adventitia) didn't change significantly after the mid 40's because of the constant thickness of the media. This result was different from what was reported by Vancov et al [2], which may be because different arteries were studied. With increasing age, the content of elastin fibers decreased and collagen fibers increased [3], which implied that the thickening of the intima and media was the result of deposit of collagen fibers. Because collagen fibers are much stiffer than elastin fibers, the deposition of collagen fibers led to increased modulus, therefore stiffening, of the arterial wall in the older specimens [4]. Further study on the structural changes of the arterial wall is necessary to fully understand the differences in arterial functions due to aging.

***Figure 1**. The thickness of the intima, IEL, and EEL*

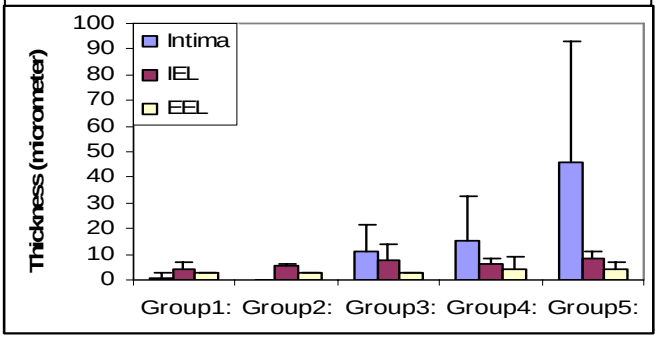


***Figure 2**. The thickness of the intima, media, and adventita*

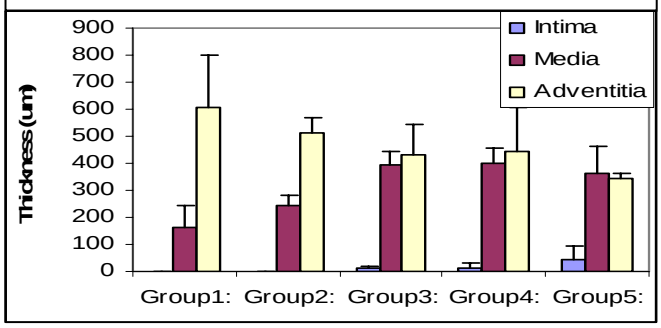
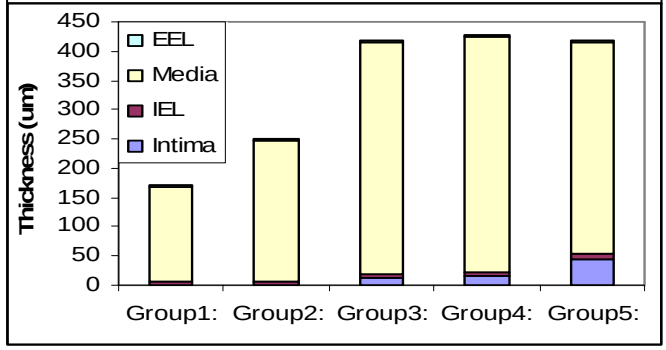


***Figure 3.** The thickness of the arterial wall with the components of the intima, IEL, media, and EEL*



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