Left Atrial Appendage Morphology among Egyptian Patients By Multi-Detector Computed Tomography

Thesis

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List of Abbreviations

Abb.	Full term
3D	*Three-Dimensional*
AF	*Atrial Fibrillation*
CCTA	*Cardiac Computed Tomography Angiography*
CTA	*Computed Tomography Angiography*
EF	*Ejection Fraction*
LA	*Left Atrium*
LAA	*Left Atrial Appendage*
MDCT	*Multi-Detector Computed Tomography*
MRI	*Magnetic Resonance Imaging*
NS	*Not significant*
S	*Significant*
SD	*Standard Deviation*
TEE	*Transesophageal Echocardiography*
TIA	*Transient Ischemic Attack*

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ABSTRACT

Our results also showed that females are more likely to have a Cactus or Windsock morphology (34% each), and are least likely to have a Chicken Wing morphology (7.9%). On the other hand, males are more likely to have a Chicken Wing morphology (34.7%) and are least likely to have a Cactus morphology (11.5%). Females have a larger LAA volume but a smaller LAA length than males. Females have mainly low LAA orifice position while males have mainly low and mid LAA orifice position, but interestingly most of the high LAA orifice position where females.

Our results also show a possible association between Chicken Wing left atrial appendage morphology and a higher incidence and severity of coronary artery disease.

Keywords: Left Atrial Appendage - Computed Tomography Angiography - Cardiac Computed Tomography Angiography

INTRODUCTION

The left atrial appendage (LAA) is a finger-like projection that extends from the main body of the left atrium ***(Beigel et al., 2014).*** It forms during the fourth week of embryonic development and is later displaced by the fully developed left atrium ***(Beutler et al. 2014).***

The LAA has developmental, structural, and physiological characteristics distinct from the left atrium proper ***(Al-Saady et al., 1999).*** It lies anterior and lateral to the left pulmonary veins on the LA ***(Beutler et al., 2014).***

The LAA was originally considered a relatively insignificant portion of cardiac anatomy. However, it is now well recognized as a structure with important pathological implications. The LAA is the cause of thrombi formation in more than 90% of strokes in patients with non-valvular atrial fibrillation ***(Goitein et al., 2017).***

Certain LAA morphology types may affect the LA flow velocity and coagulation tendency. In some recent studies, unique LAA morphologies (cauliflower, cactus, and windsock compared to chicken wing) and a larger LAA volume were associated with prevalent stroke/TIA events ***(Kong et al., 2013).***

Therefore to avoid stroke, the recognition of LAA morphology and susceptibility to thrombus formation would be helpful.

Although anticoagulation therapy in indicated patients reduces the risk of thromboembolism, it has a narrow therapeutic range and carries a significant bleeding risk along with a low patient compliance to treatment leading to a clinical utilization in only 50–60%. Current research is aiming to anatomically target the LAA itself for stroke prevention ***(Goitein et al., 2017).***

Several devices have been developed to allow for percutaneous LAA occlusion. Currently available percutaneous device therapies permit occlusion of left atrial appendages with a maximal orifice diameter of 31 mm ***(Walker et al., 2012).***

The recent development of a percutaneous LAA occlusion device emphasizes the need for an accurate understanding of the LAA anatomy. Optimal device sizing and selection prior to occlusion is of importance, affecting procedure success and duration. The LAA is a complex anatomical structure varying significantly in size, shape and spatial configuration, which emphasizes the importance of studying the LAA anatomy.

Much variability exists in the prevalence of different LAA morphologies in different populations. Multiple studies

have shown the chicken wing morphology to be the most prevalent among the different LAA morphologies in all age groups, followed by the windsock and cactus morphologies, with the cauliflower morphology being the least prevalent ***(Hirata et al., 2016).***

Other studies have shown other morphologies to be most prevalent including windsock ***(Korhonen et al., 2015)*** and cactus ***(Fukushima et al., 2015).***

In a study carried out on a Chinese population, chicken wing LAA morphology was found to be prevalent in 52.2% of patients followed by windsock in 23.9% followed by cauliflower in 13.0% followed by cactus in 10.9% ***(Kong et al., 2013).*** This suggests that racial differences may be present in the prevalence of different LAA morphologies.

Aim of the Work

The aim of this thesis is to study the morphology and size of the left atrial appendage in consecutive Egyptian patients.

Chapter 1

THE LEFT ATRIAL APPENDAGE ANATOMICAL CONSIDERATIONS

The left atrial appendage (LAA) is a muscular pouch connected to the left atrium. It has structural and physiological characteristics distinct from the left atrium proper, and varies between individuals in structure ***(Jinho & Ban, 2013).***

Embryology

The LAA is an embryological remnant of the primordial left atrium. It is derived from the left wall of the primary atrium, which forms during the third to fourth week of embryonic development ***(Al-Saady et al., 1999).***

The LAA is the original embryologic structure that acts as the left atrium. It forms during the third week of gestation and is later displaced by the fully developed left atrium. This occurs as the smooth walled pulmonary veins from the left atrium, and the trabeculated tissue that forms the LAA migrates anterior and laterally. This results in a smooth-walled left atrium and pectinate muscle lining the LAA ***(Beutler et al., 2014).***

Anatomy

Anatomically, the LAA lies in the atrioventricular sulcus, related to the left circumflex artery and the upper and lower left pulmonary veins and the left phrenic nerve ***(Di Biase et al., 2012).***

The LAA lies within the pericardium, next to the superior lateral aspect of the left ventricular free wall ***(Jinho & Ban, 2013).***

The morphology of the LAA is variable. It has a long tubular structure, that may be hooked and/or have multiple lobes ***(Di Biase et al., 2012).***

Function

The LAA function in the fully developed human heart is involved in hemodynamic and neurohumoral regulation ***(Beutler et al., 2014).***

The LAA lies within the pericardium in close relation to the free wall of the left ventricle and thus its emptying and filling may be significantly affected by left ventricular function. The physiological properties and anatomical relations of the LAA render it ideally suited to function as a decompression chamber during left ventricular systole and during other periods when left atrial pressure is high ***(Al-Saady et al., 1999).***

These functional physiological properties of the LAA include the position of the LAA high in the body of the left