



HEART. CIRCULATORY SYSTEM. AORTA. COMMON CAROTID ARTERY

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ABSTRACT

This article examines the anatomical structure of the heart, the systemic and pulmonary circulatory pathways, the morphological and functional characteristics of the aorta, and the topography and clinical significance of the common carotid artery (*arteria carotis communis*). The heart, as the central muscular organ of the cardiovascular system, ensures continuous blood circulation and plays a fundamental role in supplying oxygen and nutrients to all tissues. The circulatory pathways maintain gas exchange and metabolic homeostasis throughout the body. The aorta is the largest artery in the human body, originating from the left ventricle and delivering oxygenated blood to all organs and systems. The common carotid artery is one of the principal vessels of the head and neck, essential for maintaining adequate cerebral perfusion. This study is based on the analysis of modern anatomical literature and provides a scientific evaluation of the functional interrelationship among the key components of the cardiovascular system. The findings have both theoretical and practical significance for the advanced study of heart anatomy and major arterial structures.

Keywords: heart, circulatory system, systemic circulation, pulmonary circulation, aorta, common carotid artery, anatomy, blood vessels.

INTRODUCTION

The cardiovascular system is one of the most essential physiological systems in the human body, responsible for supplying oxygen, nutrients, and biologically active substances to all cells and tissues. The heart, as the central organ of this system, continuously contracts to maintain blood circulation through the systemic and pulmonary circulatory pathways. Understanding the anatomical structure of the heart, including its chambers, valves, and relationship with major blood vessels, is crucial not only for comprehending normal physiological processes but also for diagnosing and managing cardiovascular diseases.

The circulatory pathways represent a complex hemodynamic mechanism essential for sustaining life. The systemic circulation begins in the left ventricle and delivers oxygenated blood to all tissues through the aorta, while venous blood returns to the heart through the venous system. The pulmonary circulation originates in the right ventricle and facilitates gas exchange within the lungs. The anatomical and functional integrity of these two circulatory circuits plays a decisive role in maintaining metabolic homeostasis in the human body.

The aorta is the largest elastic artery in the human body, originating from the left ventricle and divided into the ascending aorta, the aortic arch, and the descending aorta. Its specialized wall structure allows it to withstand and regulate high-pressure blood flow. Through the aorta, all vital organs receive oxygenated arterial blood, making the detailed study of its anatomy highly significant in clinical anatomy and medical practice.

The common carotid artery (*arteria carotis communis*) is one of the principal arterial vessels of the head and neck. It plays a direct role in supplying blood to the brain, face, and cervical structures.



Its topographic anatomy is of particular diagnostic importance in conditions associated with cerebral circulation disorders and vascular pathologies.

The aim of this study is to analyze the anatomical structure of the heart, the circulatory pathways, the aorta, and the common carotid artery, as well as their functional interrelationships, based on modern anatomical literature and scientific evidence.

MATERIALS AND METHODS

This scientific study was conducted as a theoretical and analytical investigation aimed at examining the anatomical structure of the heart, the circulatory pathways, the aorta, and the common carotid artery, as well as their functional interrelationships. The research was based on the analysis of modern and classical anatomical literature, atlases, and international scientific sources. Primary data were collected and evaluated using fundamental textbooks in human anatomy, including **Gray's Anatomy**, **Sobotta Atlas of Human Anatomy**, **Netter's Atlas of Human Anatomy**, as well as scientific publications related to clinical anatomy and the cardiovascular system.

Several scientific methods were applied comprehensively throughout the study. First, the **literature review method** was employed to systematically analyze existing scientific information regarding the external and internal structure of the heart, its anatomical compartments, circulatory pathways, and major arterial vessels. Anatomical descriptions provided by different authors were compared to identify both common and distinctive features.

In the second stage, a **comparative anatomical analysis** was performed to evaluate the topographical location, branching patterns, and functional significance of the major arteries originating from the heart, particularly the aorta and the common carotid artery. The physiological roles of the arterial system and anatomical changes associated with pathological conditions were also considered from a theoretical perspective.

Additionally, the **morphological descriptive method** was used to provide a detailed characterization of the layers of the heart wall, the valvular apparatus, the elastic properties of the aortic wall, and the structural organization of the common carotid artery. Anatomical terminology was applied according to the international standards of **Terminologia Anatomica**, ensuring scientific precision and terminological consistency.

To enhance the reliability of the findings, data from multiple scientific sources were cross-verified and compared with current anatomical perspectives. The obtained scientific evidence provides a methodological foundation for a deeper understanding of cardiovascular anatomy and its integration with clinical medical disciplines.

RESULTS

The study systematically analyzed the anatomical structure and functional interrelationships of the heart, circulatory pathways, the aorta, and the common carotid artery. The findings confirmed the morphological integrity of the cardiovascular system and its central role in maintaining vital physiological functions.

The heart was identified as a four-chambered muscular organ composed of the right and left atria and the right and left ventricles. The heart wall consists of three principal layers: endocardium, myocardium, and epicardium. The myocardium of the left ventricle was found to be significantly thicker, reflecting its function in generating the high pressure required for systemic circulation.

The circulatory system was anatomically confirmed to consist of two major circuits. The pulmonary circulation transports venous blood to the lungs for gas exchange, while the systemic circulation delivers oxygenated blood to all tissues and organs. The functional continuity of these two circuits ensures uninterrupted oxygen supply throughout the body.

The aorta was identified as the largest elastic artery originating from the left ventricle and divided into three main segments: the ascending aorta, the aortic arch, and the descending aorta. Each segment performs specific anatomical and physiological roles in systemic blood distribution.

The common carotid artery was observed to originate from the brachiocephalic trunk on the right side and directly from the aortic arch on the left side. It bifurcates into the internal and external carotid arteries in the cervical region, supplying blood to the brain, face, and neck structures.

Table 1. Anatomical and functional characteristics of the heart and circulatory pathways

Anatomical structure	Primary function	Clinical significance
Heart	Blood propulsion and pressure generation	Heart failure, arrhythmias
Pulmonary circulation	Gas exchange in the lungs	Pulmonary hypertension
Systemic circulation	Oxygen delivery to tissues	Hypertension, ischemia

Table 2. Comparative characteristics of the aorta and common carotid artery

Parameter	Aorta	Common carotid artery
Origin	Left ventricle	Brachiocephalic trunk (right), aortic arch (left)
Primary role	Systemic arterial blood supply	Blood supply to head and neck
Wall type	Elastic artery	Musculo-elastic artery
Common pathologies	Aneurysm, atherosclerosis	Stenosis, thrombosis

The results demonstrate that the anatomical integrity of the heart and major arteries is a fundamental determinant of hemodynamic stability and overall physiological homeostasis.

DISCUSSION

The findings of this study further confirm the crucial importance of the anatomical structure and functional unity of the cardiovascular system in maintaining human life. The four-chambered structure of the heart and its valvular apparatus ensure unidirectional blood flow and contribute to the maintenance of hemodynamic balance. In particular, the increased thickness of the left ventricular myocardium represents a morphological adaptation necessary for generating the high pressure required for systemic circulation. These observations are fully consistent with classical anatomical references, including *Gray's Anatomy* and *Netter's Atlas of Human Anatomy*.

The systemic and pulmonary circulatory pathways function as a single integrated system responsible for balancing oxygen and carbon dioxide exchange throughout the body. Any anatomical or functional disturbance within the pulmonary circulation may lead to impaired gas exchange and systemic hypoxia. Likewise, abnormalities in systemic circulation can result in ischemic changes in peripheral tissues. These findings highlight the necessity of studying cardiovascular anatomy in close connection with clinical medical practice.

The structure of the aorta as an elastic artery enables it to perform an essential hemodynamic buffering function. The abundance of elastic fibers in the aortic wall plays a critical role in moderating high-pressure blood flow generated by ventricular contraction. The major branches arising from the aortic arch supply blood to the head, neck, and upper limbs, illustrating the anatomical continuity



between central cardiac function and peripheral circulation. Consequently, aortic pathologies such as aneurysm and atherosclerosis can significantly affect overall physiological stability.

The anatomy of the common carotid artery, particularly its bifurcation region, holds special clinical relevance in neurology and vascular surgery. The accumulation of atherosclerotic plaques in this region may impair cerebral blood flow and increase the risk of ischemic stroke. The present findings emphasize the importance of a detailed understanding of the topographical anatomy and functional significance of the common carotid artery for both diagnostic and surgical applications.

Overall, the anatomical and functional integrity of the heart, circulatory pathways, the aorta, and the common carotid artery represents one of the fundamental determinants of physiological homeostasis. Their comprehensive study provides essential scientific foundations not only for basic anatomical sciences but also for the advancement of cardiology, neurology, and vascular surgery.

CONCLUSION

This scientific study enabled a systematic analysis of the anatomical structure of the heart, the circulatory pathways, the aorta, and the common carotid artery, as well as their functional interrelationships. The findings demonstrate that the morphological integrity of the cardiovascular system is one of the fundamental factors ensuring hemodynamic stability and metabolic homeostasis in the human body.

The four-chambered structure of the heart and its valvular apparatus ensure efficient unidirectional blood flow. The systemic and pulmonary circulatory pathways function in close coordination to maintain oxygen delivery and carbon dioxide removal throughout the body. The elastic wall structure of the aorta plays a crucial role in regulating arterial pressure, while the common carotid artery ensures continuous blood supply to the brain and cervical tissues.

The results confirm that a detailed understanding of cardiac and vascular anatomy provides an essential theoretical foundation for clinical practice, particularly in cardiology, neurology, angiology, and vascular surgery. Comprehensive anatomical knowledge is of great importance for the early diagnosis, prevention, and effective treatment of cardiovascular diseases.

Therefore, the in-depth study of the anatomical and functional characteristics of the heart, circulatory pathways, the aorta, and the common carotid artery remains a highly relevant area of modern medicine and provides an important basis for future scientific investigations.

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