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OPERATIVE SURGERY OF THE UPPER AND LOWER LIMBS: SURGICAL APPROACHES TO ARTERIES AND PERIPHERAL NERVES

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Abstract
This article highlights the clinical-anatomical and surgical principles of operative surgery of the upper and lower limbs. In particular, it analyzes the anatomical location and significance in surgical practice of the subclavian, axillary, brachial, radial, and ulnar arteries, as well as the external iliac, femoral, popliteal, and leg arteries, together with treatment approaches used in vascular injuries. Particular attention is paid to the main types of vascular sutures, the topographic anatomy of peripheral nerves, the assessment of nerve injuries, and the theoretical foundations of their repair using microsurgical techniques. The article also substantiates the importance of anatomical knowledge, diagnostics, and an individualized surgical approach in modern operative surgery.

Keywords: Operative surgery, upper limb, lower limb, arteries, vascular suture, peripheral nerves, topographic anatomy, microsurgery, nerve regeneration, vascular injuries.

Introduction

Operative surgery is one of the important fields of medical science and studies the anatomical and theoretical foundations of treating various pathological processes in the human body by surgical methods. In particular, operations involving the blood vessels and peripheral nerves of the upper and lower limbs are of special importance in modern surgical practice. This is because damage to these anatomical structures can lead to impaired blood circulation, reduced oxygen supply to tissues, and limitations in sensory and motor function. An in-depth study of the topographic anatomy of the upper and lower limbs is important for establishing the theoretical foundations of surgical interventions. The arteries located in the subclavian, axillary, brachial, forearm, and elbow regions provide the blood supply to the upper limb. The external iliac, femoral, popliteal, and leg

arteries participate in the arterial blood supply to the tissues of the lower limb. Knowledge of the anatomical locations of these vessels and their relationships with adjacent neuromuscular structures is essential for ensuring surgical safety. Surgical procedures involving peripheral nerves are also an important component of operative surgery. As a result of trauma, compression syndromes, and other pathological conditions, the anatomical integrity or functional activity of nerves may be impaired. In such situations, determining the degree of nerve injury, assessing its functional condition, and studying the possibilities for its restoration are of great clinical importance. The aim of this study is to scientifically analyze the topographic and anatomical features of the main arteries and peripheral nerves of the upper and lower limbs, as well as the modern theoretical principles of vascular suturing and nerve repair.

Literature Review and Methodology

A review of the scientific literature on operative surgery and topographic anatomy demonstrates that the anatomical location of blood vessels and peripheral nerves directly affects the outcomes of surgical interventions. In particular, knowledge of the relationships between neurovascular bundles in the upper and lower limbs is an important theoretical foundation of surgical practice.

The textbook “Fundamentals of Surgery and Resuscitation” by A.J. Hamrayev and A.V. Alimov covers the general principles of surgery, bleeding, asepsis, antisepsis, and the main aspects of surgical care. This source is important for studying general surgical approaches to vascular injuries [1].

The textbook “Surgical Diseases,” authored by A.S. Babajanov and A.I. Axmedov and published in 2024, describes the diagnosis, clinical course, and treatment methods of surgical diseases, as well as the prevention of postoperative complications. This publication is one of the important sources for analyzing modern surgical approaches. The research methodology was based on comparative analysis, the study of scientific literature, clinical-anatomical description, and systematic generalization. The arterial systems of the upper and lower limbs, the anatomical features of peripheral nerves, the theoretical foundations of vascular sutures, and modern principles of nerve repair were studied in relation to one another [2].

During the analysis, the anatomical location of arteries, their relationships with adjacent anatomical structures, the importance of maintaining blood circulation, and the functional characteristics of peripheral nerves were identified as the main criteria. The arterial blood supply to the upper limb begins with the subclavian artery and continues through the axillary and brachial arteries. The brachial artery subsequently divides into the radial and ulnar arteries in the elbow region. These vessels supply blood to the muscles, bones, skin, and other soft tissues of the upper limb.

The subclavian artery is one of the main sources of arterial blood supply to the upper limb, and its anatomical location is closely related to the upper part of the thoracic cavity, the

clavicle, and the neck region. When studying the surgical anatomy of this artery, the relationships between major veins, nerve plexuses, and adjacent anatomical structures are important. The axillary artery is located in the axillary region and is the continuation of the subclavian artery. It gives rise to branches that supply the shoulder girdle and some muscles of the upper limb. Because the artery is in close anatomical relationship with the components of the brachial plexus in this region, preserving their functional integrity during surgical procedures is important [3].

The brachial artery is the main arterial trunk of the upper limb and is located in the anterior part of the arm. Its anatomical structure is characterized by its division into the radial and ulnar arteries in the region of the cubital fossa. Injury to the brachial artery may cause a severe disruption of blood circulation in the distal parts of the upper limb. The radial and ulnar arteries play an important role in supplying arterial blood to the hand. They form anastomoses with each other and participate in the formation of the superficial and deep palmar arterial arches. These anatomical connections make collateral circulation in the hand possible.

The arterial blood supply to the lower limb is provided through the femoral artery, which is the continuation of the external iliac artery. The femoral artery is one of the main arterial trunks of the lower limb and is located in the anterior anatomical region of the thigh. It is an important component of the arterial system that delivers blood to the distal parts of the lower limb. The external iliac artery is located in the pelvic region and is the main anatomical structure through which the arterial blood supply passes to the lower limb. Its continuation as the femoral artery ensures the continuity of blood circulation between the pelvic and thigh regions.

The femoral artery is anatomically connected with the knee region and continues as the popliteal artery. The popliteal artery lies close to the anatomical structures surrounding the knee joint. Its branches participate in supplying blood to the knee joint and surrounding tissues. The arteries of the leg consist of the main anterior and posterior branches. The anterior tibial artery plays an important role in the blood supply to the dorsum of the foot, while the posterior tibial artery supplies the plantar surface of the foot. Their branches form a complex system of arterial anastomoses in the foot. In studying these arteries, the continuity of blood circulation, collateral blood supply, and preservation of tissue viability are the main areas of scientific interest. The choice of diagnostic and treatment methods for arterial injuries depends on the location and severity of the injury, distal blood circulation, and the patient's general condition.

Surgical exposure of arteries is important in cases of vascular injuries, pathological changes, and certain reconstructive operations. This surgical approach is based on topographic anatomy, the relative locations of blood vessels, and consideration of the surrounding neuromuscular structures. Ligation of arteries is one of the surgical methods used to control bleeding. However, when choosing this method, the blood supply to distal tissues, the development of collateral circulation, and the functional condition of the organ

must be assessed separately. This is because occlusion of a major arterial vessel may, in some cases, lead to ischemic changes in tissues.

Discussion and Results

In modern vascular surgery, priority is given to preserving the anatomical and functional integrity of the vessel as much as possible, restoring blood flow, and ensuring normal tissue perfusion. For this reason, reconstructive and restorative methods are important alongside arterial ligation. Vascular suturing is a surgical method aimed at restoring the anatomical integrity of the vessel wall and ensuring continuity of blood flow. It is used in vascular injuries, reconstructive operations, and certain pathological conditions.

The main purpose of a vascular suture is to ensure the tightness of the vessel wall, reduce deformities that obstruct blood flow, and lower the risk of thrombus formation inside the vessel. The quality of the suture depends on the condition of the vessel wall, the nature of the injury, and the anatomical precision of the repair process.

Vascular sutures are classified according to the shape of the vessel being repaired and the degree of injury. In particular, lateral repair is considered for limited injuries to the vessel wall, while reconstructive approaches are considered in cases of vessel transection or large defects. In some complex cases, vascular plasty or prosthetic replacement may be used. The development of microsurgical technologies has expanded the possibilities for vascular repair. Modern optical magnification devices and specialized surgical materials make it possible to perform highly precise reconstructive procedures even on vessels of small diameter.

The peripheral nervous system of the upper limb is formed mainly by nerves arising from the brachial plexus. The most important of these are the median, ulnar, radial, musculocutaneous, and axillary nerves. These nerves provide the motor and sensory functions of the upper limb. The median nerve is involved in the function of many muscles of the forearm and hand. The ulnar nerve is important for certain intrinsic muscles of the hand and the sensation of the fingers. The radial nerve provides the function of the extensor muscles of the arm and forearm [4].

In the peripheral nervous system of the lower limb, the femoral, obturator, sciatic, tibial, and common fibular nerves play important roles. The femoral nerve is associated with the function of the anterior group of thigh muscles. The sciatic nerve is one of the largest peripheral nerves in the body and participates in the innervation of many anatomical structures of the lower limb. The tibial and common fibular nerves are important for the movement and sensation of the foot. Their injury may lead to impaired movement of the foot and disruption of the mechanism of walking. When studying the operative anatomy of peripheral nerves, their relationships with muscles, blood vessels, fasciae, and bony structures are important. These anatomical features form the theoretical basis for identifying nerve injuries and repairing them.

Peripheral nerve injuries may occur as a result of traumatic, compressive, or other pathological factors. The degree of damage to nerve fibers varies; in some cases, functional impairment is temporary, while in others it may be long-lasting. The main goal of nerve repair is to restore, as far as possible, the anatomical integrity and functional capacity of the injured nerve. This requires consideration of the type of nerve injury, the duration of the injury, the anatomical characteristics of the affected region, and the regenerative capacity of the nerve fibers.

Methods used in nerve surgery include neurolysis, nerve suturing, nerve grafting, and nerve transplantation. Neurolysis is aimed at reducing the effect on a nerve of compressive scar tissue or other surrounding tissues. Nerve suturing serves to restore the continuity of an injured nerve. In cases of extensive nerve defects, reconstructive methods, including nerve transplantation, may be considered. The development of microsurgical techniques helps improve the effectiveness of peripheral nerve repair. Surgical outcomes are influenced by the anatomical condition of the nerve, the timeliness of repair, the patient's individual characteristics, and the subsequent rehabilitation process. Nerve recovery is a complex biological process associated with the regeneration of nerve fibers, reinnervation, and restoration of neuromuscular connections. Therefore, rehabilitation after surgical treatment, physiotherapeutic approaches, and functional monitoring are important components of treatment [5].

In operative surgery of the upper and lower limbs, the integration of clinical anatomy, instrumental diagnostics, and modern surgical technologies is important. Doppler ultrasonography, duplex scanning, computed tomography angiography, and magnetic resonance imaging make it possible to assess the condition of blood vessels and nerve structures. In particular, in vascular injuries, it is important to assess arterial blood flow, determine the level of tissue perfusion, and establish the need for reconstructive treatment. In peripheral nerve injuries, clinical neurological examinations, electroneuromyography, and imaging diagnostic methods may be used. The analyses show that vascular and nerve surgery must take into account not only anatomical knowledge but also functional outcomes. The main goal of surgery is not only to restore the injured anatomical structure but also to preserve the motor, sensory, and circulatory functions of the limb [6].

Conclusion

Operative surgery of the upper and lower limbs is an important medical field closely related to clinical anatomy, vascular surgery, and peripheral nerve surgery. An in-depth study of the anatomical features of the subclavian, axillary, brachial, radial, and ulnar arteries, as well as the external iliac, femoral, popliteal, and leg arteries, establishes the scientific foundations for diagnosing and treating vascular injuries. Vascular sutures are an important component of modern reconstructive surgery, and their main purpose is to restore the integrity of blood vessels and maintain normal blood circulation. Repair of peripheral nerves is important for restoring motor and sensory function. Microsurgical

technologies, modern diagnostic tools, and individualized treatment approaches contribute to the development of this field. Overall, an in-depth study of operative surgery of the upper and lower limbs plays an important role in developing the clinical thinking skills of future medical specialists, strengthening their anatomical knowledge, and understanding the scientific foundations of modern surgical practice.

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