



COLLECTION OF SCIENTIFIC PAPERS



ISSUE
№8

1 INTERNATIONAL SCIENTIFIC
AND PRACTICAL CONFERENCE

**SCIENCE AND
INFORMATION
TECHNOLOGIES
IN THE MODERN WORLD**

FEBRUARY 26-28, 2025
ATHENS, GREECE





INTERNATIONAL SCIENTIFIC UNITY

1st International Scientific and Practical Conference
**«Science and Information Technologies in the
Modern World»**

Collection of Scientific Papers

February 26-28, 2025
Athens, Greece

UDC 01.1

Science and Information Technologies in the Modern World: Collection of Scientific Papers "International Scientific Unity" with Proceedings of the 1st International Scientific and Practical Conference. February 26-28, 2025. Athens, Greece. 541 p.

ISBN 979-8-89704-987-5 (series)
DOI 10.70286/ISU-26.02.2025

The conference is included in the Academic Research Index ReserchBib International catalog of scientific conferences.

The collection of scientific papers "International Scientific Unity" presents the materials of the participants of the 1st International Scientific and Practical Conference "Science and Information Technologies in the Modern World" (February 26-28, 2025).

The materials of the collection are presented in the author's edition and printed in the original language. The authors of the published materials bear full responsibility for the authenticity of the given facts, proper names, geographical names, quotations, economic and statistical data, industry terminology, and other information.

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ISBN 979-8-89704-987-5 (series)



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SECTION: MEDICINE

POSTNATAL TRANSFORMATIONS OF THE INTRAMURAL APPARATUS OF THE HUMAN UMBILICAL VEIN

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Relevance: During the development of the organism, sequential changes occur within its cellular, tissue, and organ structures, ultimately leading to their morphophysiological specialization. However, in some organs, these processes progress somewhat uniquely during postnatal life. This is evident in the umbilical vein, which loses its primary function immediately after birth but remains part of the body's natural system of connections.

Currently, this issue is insufficiently studied; most research focuses on the final outcomes of postnatal transformations, considering factors such as wall thickness, the presence of a lumen, and the degree of patency. While these aspects are undoubtedly significant for clinical medicine, they do not fully capture the complexity of the process.

The aim of this study: To examine the condition of the intramural nerve elements of the umbilical vein at different stages of postnatal life.

Materials and Methods: *Theoretical methods:* Review and analysis of scientific and methodological literature. *Practical methods:* Original research.

Results and Conclusions: Histological examination of the umbilical vein revealed that, despite the complete loss of its original function, the overall structure of the vascular wall and its lumen remain preserved. Postnatal life brings about certain structural changes within the vein's layers, particularly in its nerve elements, which proved to be the most labile in terms of both quality changes and the nature of their innervation connections to the surrounding tissues.

In full-term stillborn infants, a significant number of nerve elements were found in the umbilical vein, including nerve bundles, individual fibers, and nerve endings, indicating the vessel's functional maturity at birth. Among the layers, the outer layer exhibited the highest density of nerve structures, followed by the middle layer, and finally, the intima.

Examinations of the umbilical vein in older children (from 3 months of age) confirmed these observations, showing progressive changes in some nerve structures over time. These changes included varicosities, fragmentation, and even granular disintegration, ultimately leading to a reduction in the overall number of nerve fibers and endings. This decline becomes particularly noticeable by the ages of 3 to 4 years.

It is likely that with age, the thinning of nerve elements in the vessel wall is explained not only by their partial degeneration but also by the absence of new nerve fiber ingrowth during the overall growth of the organ. The most reactive elements were found to be the myelinated nerve fibers and sensory nerve endings, which were predominantly represented by bush-like forms. The highest concentration of receptors, as well as nerve structures in general, was observed in the outer layer near the distal end of the vessel and in the middle layer at its boundary with the outer layer.

Some of the myelinated nerve fibers and receptors undergo degeneration, passing through stages of fragmentation and granular disintegration. In the more “resistant” fibers, as the organ grows, existing branches elongate, allowing a single receptor to innervate a larger area of tissue. In unmyelinated nerve fibers, destructive changes were less frequent and appeared significantly later, usually around the end of the first year of life.

The data indicate that destructive processes affecting nerve elements (fibers and endings) in the wall of the umbilical vein are most prominent shortly after birth and continue over the next 3–4 years. After this period, the number of altered nerve elements decreases.

In individuals aged 30–40 years, no significant changes were observed in the structure of the intramural nerve elements, although occasional individual differences were noted, possibly reflecting the nervous system’s overall response to specific physiological states.

Alongside the changes in nerve structures, shifts were also observed in the morphology of surrounding tissue elements and vessels. A clear pattern emerged: during the postnatal period, there was a gradual decrease in the density of the capillary network within the adventitia and the middle part of the media, while closer to the intima, the number of capillaries remained unchanged. The intima became slightly thicker, and the muscle elements in the middle layer were more loosely arranged, separated by connective tissue layers.

Thus, comparing the structure of the organ during its active functional period (before birth) with its post-functional state reveals a morphological reorganization that affects all tissue and structural components to varying degrees. The nervous and vascular components proved to be the most labile. However, despite the loss of its primary function, the umbilical vein remains integrated within the body’s system of connections throughout life, retaining its vascular and neural links.