Innervation Relationships of the Gallbladder Nerve Apparatus with Spinal and Rheumatic Nerve Ganglia (Literature Review)

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Abstract. *The biliary system is characterized by the presence of many sphincters, the coordinated work of which results in bile excretion into the intestine at the moment of digestion and into the gallbladder outside the moment of digestion. It has been established that there is a direct innervation connection between them. In addition, the gallbladder has innervation connections with other organs of the abdominal cavity. Therefore, in diseases of the gallbladder there are concomitant disorders of functions of other organs and clarification of the nervous mechanism of these concomitant reactions has a certain importance.*

Keywords: *Gallbladder, extrahepatic bile ducts, innervation connections.*

Introduction. In this work we analyzed scientific sources devoted to the structure, innervation connections of the gallbladder intramural nervous apparatus and extrahepatic biliary tracts, paying special attention to the innervation connections of the gallbladder with the nodes of the cranial plexus and with the spinal nerve nodes. A number of physiological and clinical scientific sources of the founders of the problem and their followers were analyzed in the aspect of clarification of these connections. The biliary system is characterized by the presence of many sphincters, from the coordinated work of which bile is excreted into the intestine at the moment of digestion and into the gallbladder outside the moment of digestion. It has been established that there is a direct innervation connection between them. In addition, the gallbladder has innervation connections with other organs of the abdominal cavity. Therefore, in diseases of the gallbladder there are concomitant disorders of the functions of other organs

and clarification of the nervous mechanism of these concomitant reactions is of some importance. In recent years, a number of scientific works have been studied, which challenged the classical notion that the parasympathetic department of the autonomic nervous system controls only the tone of the biliary tract, and gave data that irritation of the vagus also causes gallbladder contractions. In these researches it was studied that stimulation of sympathetic nerves, inhibits contraction of gallbladder muscles, in turn, increases activity of Oddi sphincter muscles. In some cases the authors of scientific works consider that in some research conditions sympathetic nerve, with serotoninergic fibers passing in it, increase the vagus stimulation of the biliary tract motility.

Researchers studied intramural nerve apparatus of gallbladder of experimental animals when the right vagus nerve was cut. These studies show that there are inter-neural connections both of central and peripheral origin in the gallbladder. When studying the nodes of the cranial plexus in experimental animals with cholecystectomy, scientists came to the conclusion that morphological changes of some structural components of this node are observed in these animals. These data prove that the nodes of the rheumatic plexus are those peripheral centers, which are the place of functional interactions and concomitant diseases of the abdominal cavity organs. Extrahepatic bile ducts as well as their valve and sphincter apparatus by structure are considered as complex, and by function as actual structures of digestive tract. Strictly coordinated work of sphincters of extrahepatic ducts, depending on function of duodenum requires reliable nervous apparatus, which provides bile secretion at the moment of chyme passing through duodenum, and into gallbladder, outside of digestion in it. From the above data, the innervation of these bile ducts is a hot topic for neurohistologists, and it also attracts the attention of morphologists and clinicians at the present time. It is known that acute pain caused by stones blocking the common bile duct is one of the leading symptoms of biliary diseases sometimes called "embedded stones". This is because there is a high concentration of nerve elements in this area. Therefore, morphologists believe that it is necessary to study

carefully the morphology of the intramural nervous apparatus of biliary tracts. Literature data on the innervation of gallbladder and biliary tracts show that, for example in guinea pig, internal ganglionic nerve plexus of extrahepatic biliary tract contains more than 3000 neurons. Actions of these neurons are modulated by external sympathetic, parasympathetic, external sensory and duodenal nerve inputs. Modern scientific evidence suggests that the nature of functional disorders of the gastrointestinal tract, as well as heterogeneous clinical symptomatology are related to the anatomical features of the structure of the gastrointestinal tract, sphincter apparatus of the gastrointestinal tract, regulation of neurohumoral processes. The gallbladder contains various regulatory influences of the central and peripheral nervous systems, hormones and peptides of the stomach, which allow to synchronize the sequential physiological processes of biliary excretion.

According to the biopsychosocial model of functional gastrointestinal disorder, pathogenic mechanisms are based on the disruption of the relationship between the target organ and regulatory systems, resulting in cumulative disorders of pain and motor function of the organ. The main reasons of primary biliary tract functional disorders are psychosocial factors and social degradation related to genetic factors that determine the character of motor disorder and contribute to formation of biliary tract hypersensitivity. At the same time functional disturbances of bile ducts influence psychoemotional state of a patient and also worsen quality of life of a patient. Psychogenic factors exert their role on the gallbladder and bile ducts through cortical and subcortical structures, centers of the medulla oblongata and hypothalamus. Negative emotions and frequent stressful situation is accompanied by nervous system dysfunction in the cerebral cortex, vegetative center regulation deterioration, formation of "stagnant" excitation foci in hypothalamus and reticular formation, contributing to development of functional disorders of biliary tract. Modern scientists study the mechanisms of hereditary influence of the central nervous system on functional disorders of the gastrointestinal tract.

Unfavorable risk factors of the disease, affecting the regulation of the neurohumoral system, lead to disorders of the motor function of the biliary tract, these processes, in turn, often occur with a burdened heredity. Autonomic status disorder - a factor that predetermines the likelihood of development, the severity of diseases of the digestive system. Currently, almost all researchers confirm that autonomic nervous system dysfunctionality is a pathogenetic precondition for the development of gastrointestinal pathology. Cholinergic, adrenergic and serotonergic sections of the autonomic nervous system are involved in the regulation of motor activity of the biliary system and provide a synchronized sequence of contraction and relaxation of the biliary tract. Most often at a young age there are vegetative disorders, which indicates the need to find modern solutions of diagnosis, treatment and prevention. At diseases of digestive system, the reason of biliary tract motor dysfunction may be a disorder of liberine and statin production in hypothalamus. At present, there is little information and evidence for internal afferent neurons or internal reflex circuits in the gallbladder. However, there is evidence suggesting that interactions between nociceptive afferents, gallbladder neurons probably play a role in the manifestation of cholecystitis and the associated discomfort modalities of distension, pain, and inflammation. In addition, neuroplasticity and neurodegeneration correlate with an increased incidence of gallstones in the elderly. Naturally, the question arises what is the physiology and pathobiology of the nervous tissue in the biliary tract, also how it is organized, the types of neurons it contains external input that affects its function, and to what extent, if any, the effects of circulating hormones and inflammatory mediators on the gallbladder are mediated through internal neurons. One of the leading symptoms of gallbladder diseases is pain.

Nozioreception is perceived by gallbladder receptors, which are dendrites of sensitive neurons of the spinal nodes. In diseases of the gallbladder, receptor neurons involved in its innervation must exhibit retrograde reaction. This reaction, of course, depends on the type, severity, duration of the disease, as well as on the performed surgical manipulations. Research concerning the study of spinal node

morphology and its changes during the last several years of internal organs diseases allows us to suggest that innervation connections of gallbladder nerve apparatus with spinal and rheum nodes are not fully established and this problem is far from its final solution. A certain number of patients after the surgery suffer from postcholecystectomy syndrome. Gallbladder diseases are accompanied by concomitant dysfunctions of other abdominal organs and cardiovascular system (cholecystoduodenitis, cholecystopancreatitis, cholecystohepatitis, cholecystocardial syndromes etc.). In addition, the gallbladder influences almost all digestive organs and receives interoceptive influence from all parts of the digestive tract. On what material substrate do these interoceptive influences occur and what is their mechanism, is one of the insufficiently studied questions. In all gallbladder diseases, one of the leading symptoms is acute pain. And sensory innervation of the gallbladder is carried out by the spinal nodes. Clarification of the topography of the spinal nodes specifically involved in the sensitive innervation of the gallbladder also requires additional investigations.

Conclusions: Thus, the interaction of internal organs occurs according to the type of visceral and visceral reflexes, which are closed in the nodes of the rheumatic plexus. There are works concerning the study of the morphology of spinal and rheum plexus nodes. However, data on the morphology of these nodes after experimental cholecystectomy are insufficient.

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