

MINI REVIEW

A Modern View on the Issue of Enterosorption: Choosing the Optimal Drug

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Abstract

The article provides an overview of the literature on the role of sorption detoxification using intestinal adsorbents (enterosorption method) in the multifaceted treatment of various diseases. The mechanism of action of adsorbents and their therapeutic effects are presented. We emphasized that intestinal adsorbent Enterosgel is a modern, effective, and safe detoxifying agent.

Keywords: adsorbent, endogenous intoxication, enterosorption, *H. pylori*, sorption detoxification, toxin

Nowadays, the method of sorption detoxification using intestinal adsorbents/sorbents (enterosorption method) is widely used in the treatment of various diseases. The therapeutic effect of enterosorption is due to the direct and mediated effects of adsorbents. The direct effects are binding and elimination of toxins, toxic metabolites, biologically active substances (neuropeptides, prostaglandins, serotonin, and histamine), pathogenic and opportunistic microorganisms, as well as viruses out of the gastrointestinal (GI) tract. The mediated effects are related with reduction or mitigation of toxic and allergic reactions, prophylaxis of endogenous intoxication, reduction in the metabolic load on the excretory organs that perform detoxification, correction of metabolic processes, restoration of integrity and permeability of the mucosa of the GI tract, as well as stimulation of intestinal motility. Extensive scientific data regarding sorption materials allows considering their use dependent upon pathogenesis in many diseases, particularly in the conditions of increasing bacterial resistance to antibacterial agents, including specific bacteriophages [3, 8, 9].

The effectiveness of intestinal adsorbents depends on physicochemical properties of the active substance. Porosity plays a crucial role in the process of mass transfer. There can be micropores, mesopores, and macropores in the sorbent. It is known that the nature of porosity influences on adsorption of different substances, thus determining therapeutic effect of the adsorbent. For example, microporous adsorbents are effective in acute poisonings since they have high adsorption capacity; whereas adsorbents with mesoporous or macroporous structure are effective in the treatment of chronic diseases accompanied

by endogenous intoxication. Chemical properties of sorbents play a major role in subdividing them into carbon-based, silicon-containing (including organosilicon and aluminosilicate), natural organic, and composite sorbents. The choice of intestinal adsorbent should be guided by the data on chemical purity of sorbent, level of standardisation, use of high technology in manufacturing, and proven clinical effectiveness [3, 8, 9].

One of the most effective intestinal adsorbents is Enterosgel, which demonstrates therapeutic effect comparable to instrumental methods of detoxification, however has very high safety and tolerability [3, 8, 11]. Enterosgel is used to detoxify the body in allergic reactions, and various diseases accompanied by endogenous/exogenous intoxication, such as infectious diseases, sepsis, diarrhea, intestinal dysbiosis, toxic and viral hepatitis, cholestasis, mushroom and alcohol poisoning, chronic kidney diseases, burns, skin diseases, hepatic and renal failure, diabetes mellitus, autoimmune and oncological diseases, bronchial asthma, and toxicosis during pregnancy [3–5, 7, 14].

The syndrome of endogenous intoxication is observed in various diseases associated with tissue damage, enhanced catabolic processes, impairment of liver and kidney functions, and impaired microcirculation. Intoxication is one of the main pathological syndromes in inflammatory diseases that require intensive care. Endogenous intoxication takes place due to accumulation of four groups of metabolites in the body, such as bacterial endotoxins and exotoxins, tissue antigens, toxic organic substances, biologically active amines and inflammatory mediators. Bacterial toxins are large hydrophilic proteins having ligands that selectively bind to cell surface receptors of sensitive cells. Some are able to enter cells by endocytosis or through the channels in the lipid bilayer of cells. Pathogenic action of bacterial exotoxins is associated with inhibition of protein synthesis in damaged tissues, whereas the main points of attachment for endotoxins are endothelium of capillaries, blood cells, and autonomic nervous system [3, 8, 9].

Medium-weight molecules (MWM), which are capable to inhibit the functional activity of T lymphocytes and B lymphocytes, phagocytic activity of leucocytes, and tissue respiration processes, play an important role in the development of endogenous intoxication. MWM content in the blood correlates with the severity of the clinical manifestations of intoxication. It is established that the endogenous intoxication as well as metabolic and immune distress are accompanied by disintegration of macrophage-lymphocyte and monooxygenase detoxification chains simultaneously with vascular-platelet hemostasis, resulting in a multiple organ failure. Thus, several factors take part in development of endogenous intoxication, the most important of which are MWM, elevation of serum enzyme activity, bacterial toxins, and reduction in antitoxic resistance of the body [3, 8–10].

The high effectiveness of intestinal adsorbent (enterosorbent) Enterosgel as a detoxifying agent in infectious and inflammatory diseases is associated with its ability to adsorb MWM and pathogenic microorganisms, thereby positively influencing the cellular and humoral immunity. Enterosgel

contributes to enhancing the functional activity of neutrophilic granulocytes to the level of subcompensation [8, 9]. Performing enterosorption using Enterosgel contributes to restoring the functional activity of T lymphocytes and B lymphocytes [8, 9].

The bacterial toxins in purulent diseases and septic complications are capable of suppressing the functional activity of T lymphocytes, which restores only after a certain period and depends upon the severity of disease. Fixation of oligopeptides and MWM onto the surface of T lymphocytes inhibits their functional activity. This is evident from the decrease in lymphocyte blast-transformation reaction (LBTR) in the presence of serum fractions containing nucleotides, MWM, and products of lipid peroxidation (PLP) [3, 8, 9]. One of the reasons behind decrease in LBTR is the action of C-reactive protein (CRP) and other acute phase proteins, which have an inhibitory effect on stimulation by phytohemagglutinin (PHA). Under such conditions, functional activity of B lymphocytes has a tendency to increase indicating a significant activation of humoral immunity in response to the antigenic stimulation. Bacterial lipopolysaccharides (LPS) can act as polyclonal mitogens. Under such conditions, B lymphocytes acquire the capability to produce low-affinity antibodies against its own erythrocytes. Thus, accumulation of toxins of bacterial origin in inflammatory diseases results in the development of secondary immunodeficiency and autoimmune reactions [8, 9].

Including intestinal adsorbent Enterosgel in the multifaceted treatment of various diseases leads to a significant decrease in plasma concentration of MWM, low molecular weight compounds, and PLP, thereby reducing the toxic load on phagocytic and immune cells. This in turn contributes to maintaining immunological reactivity on the level of subcompensation and to decreasing autosensitization in patients. Reduction of the endogenous intoxication contributes to maintaining functional activity (subcompensation) of natural detoxification factor (toxin-binding capacity of peripheral blood albumin) preventing involvement of globulins in the detoxification processes and retaining their basic functions. It is also established that one of the mediated effects of detoxification using adsorbent Enterosgel is the reduction in serum levels of proinflammatory cytokines, which indicates reduction in the intensity of systemic inflammatory response [2]. By taking into consideration the above-given data, it can be concluded that the use of Enterosgel in enterosorption depends upon pathogenesis and allows to improve significantly the effectiveness of treatment in infectious and inflammatory diseases.

The high effectiveness of enterosorbent Enterosgel has been proven in the multifaceted treatment of various diseases of the digestive system [6, 7, 11]. Gastrointestinal pathology results in disruption of the process of digestion, development of intestinal dysbiosis, and accumulation of intermediate toxic metabolites in the blood, forming the syndrome of endogenous intoxication. This causes further impairment of the functions of the liver, kidneys, cardiovascular system, metabolism, as well as inhibition of hematopoiesis and immunity [6, 7, 11]. The most pronounced manifestations of endogenous intoxication are observed in chronic disorders and diseases of the digestive system, which are

accompanied by severe disturbances in the lipid metabolism. Significant intensification of PLP contributes to damage of cell membranes and accumulation of free radicals, hydroperoxides, aldehydes, and ketones. Therefore, the prophylaxis and treatment of endogenous intoxication and intestinal dysbiosis are of a great importance.

Numerous studies testify the high effectiveness of the use of adsorbent Enterosgel for reduction of endogenous intoxication and intestinal dysbiosis. It is proven that Enterosgel effectively adsorbs toxic metabolites (bilirubin, cholesterol, nitrogenous wastes, etc.) from the intestinal lumen and the blood (through capillary membrane of mucosal villi), while the mineral salts and high molecular weight proteins (immunoglobulins) do not undergo adsorption. Enterosgel also exhibits selectivity towards microorganisms as it actively binds pathogenic and opportunistic microflora though does not inhibit the normal microflora, thus eliminating intestinal dysbiosis [3, 14]. Enterosgel coats mucous membrane of the stomach and intestine thus protecting it from erosions. It is not absorbed into the blood; it does not cause intestinal atony; and it is rapidly excreted. Thus Enterosgel has a good safety profile.

The use of Enterosgel depends upon pathogenesis in enterocolitis, colitis, and diarrhea. Administration of this adsorbent results in rapid improvement of patients' health, positive dynamics of clinical symptoms, and normalisation of intestinal microbiocenosis [13, 14].

Intestinal adsorbent Enterosgel is used for the treatment of *H. pylori*-positive peptic ulcer disease (PUD) as an adjuvant. It is proven that the accumulation of MWM and oligopeptides in patients' blood, increased toxicity index, and increased activity of NADP-dependent alcohol dehydrogenase, as well as reduction in the effective albumin concentration and reserve of toxin-binding capacity of albumin are markers of the endogenous intoxication in patients with PUD. This data is of a great practical significance and is used to look for new multifaceted treatment plans for PUD with the inclusion of detoxifying agents. The results of performed studies testify that Enterosgel is an effective adjuvant for the treatment of *H. pylori*-positive PUD. Enterosgel reliably enhances the anti-*Helicobacter* effectiveness of the standard triple therapy. At the same time, the incidence of side effects of anti-*Helicobacter* therapy is reduced and its tolerance is improved [13].

Enterosgel is widely used in the multifaceted treatment of diseases of liver [1, 11]. There are disturbances of metabolic processes in patients with acute and chronic liver impairment of various origins. Such disturbances of metabolic processes are caused by the syndrome of metabolic (endogenous) intoxication. MWM (products of proteolysis) have a toxic effect on cells of the liver, kidney, and brain neurons. Severe course of diseases of the liver leads to accumulation of toxic protein metabolites in the blood, causing the development of toxic encephalopathy and hepatic coma. Therefore, detoxification has a major significance in the treatment of liver diseases [1]. Clinical effectiveness of using Enterosgel in liver diseases is determined by both the direct and mediated effects. The direct effect is related with detoxifying action against toxic metabolites and bacterial toxins. By binding toxic substances, Enterosgel

suppresses the processes of their resorption and recirculation in the body, which reduces the metabolic and toxic load on the liver and accelerates the restoration processes. The mediated effects of Enterosgel are produced by its ability to maintain normal intestinal microbiocenosis, which in turn improves digestion and provides a high metabolic activity of enterocytes [1]. The use of Enterosgel in the multifaceted therapy of diseases of liver accelerates normalisation of biochemical parameters such as levels of bilirubin, transaminases, alkaline phosphatase, cholesterol, lipoproteins, acute phase proteins of inflammation, leucocyte count, ESR, etc. It is accompanied by clinical improvement of patients' health as there is increased appetite, disappearance of weakness and itching, as well as normalisation of stool [7, 11]. Furthermore, the use of intestinal adsorbent Enterosgel in infectious (acute) hepatitis allows shortening the terms of infusion and detoxification therapy, improving the treatment results [1, 6, 7, 11].

The ability of Enterosgel to correct the lipid metabolism by indirectly reducing the levels of cholesterol and lipoproteins in the blood substantiates its inclusion in the multifaceted treatment of cardiovascular diseases, particularly with concomitant diabetes. Optimising the therapy with enterosorbents allows significantly improving the results of treatment and quality of life in patients with ischemic heart disease [4, 5].

Thus, the results of numerous studies testify that intestinal adsorbent Enterosgel is a modern, effective, and safe detoxifying agent. By possessing selective adsorption properties, Enterosgel binds and removes bacterial toxins, endogenous products of hydrolysis, biologically active substances, pathogenic and opportunistic microorganisms, as well as viruses from the GI tract; and in addition, it adsorbs toxic metabolites from the blood. That in turn leads to reduction in the toxic and metabolic load on the excretory organs that perform detoxification, correction of the metabolic processes, reduction in the intestinal permeability, normalisation of the intestinal microbiocenosis, improvement in the motility of the GI tract, reduction in the inflammatory processes, as well as positive influence on the cellular and humoral immunity. Figuratively speaking, Enterosgel fulfils the function of an additional excretory organ that performs detoxification optimising the work of vital organs and systems. Inclusion of Enterosgel in therapeutic regimens allows significantly reducing the severity of diseases, avoiding dangerous complications (multiple organ dysfunction syndrome) and chronic pathological process.

Thanks to such an all-round positive impact on the patient's body, Enterosgel is included as a basic detoxifying agent in the multifaceted treatment for a number of diseases in adults and children.

The high adsorption capacity of Enterosgel, safety and ease of use, and ability to be combined with other medicinal products allow the doctor individualising the treatment policy, avoiding side effects of the conventional therapy, and achieving high effectiveness of the treatment while reducing its duration.

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