Introduction

Pneumatosis cystoides intestinalis (PCI) is not too a frequent disease characterized by presence of multilocular cysts in the gastrointestinal wall. idiopathic and secondary forms of the disease can be distinguished. There are presented several theories explaining pathogenesis in this article. The specific and nonspecific symptoms are described. Attention is drawn to the pneumoperitoneum without signs of peritoneal irritation, what is a typical complication of this disease. The suspicion of pneumatosis cystoides intestinalis may be based on plain abdominal X-ray, and is usually confirmed by computer tomography or magnetic resonance imaging. The therapy can be conservative or surgical. In conclusion, although pneumatosis cystoides intestinalis is a rare disease, it may represent a problem in differential diagnosis of abdominal pain.

Etiology and pathogenesis

According to Kreiss et al. (33) PCI can be classified either the idiopathic with unknown etiology (15%) or the secondary one (85%), in which the mechanism of cysts origin has been explained. Several theories elucidating the pathogenesis of this disorder have been proposed.

Mechanical theory

The mechanical theory explains the pathogenesis of pneumatosis by physical factors. Two pathogenetic mechanisms have been proposed: air leakage from lung interstitium to mediastinum, retroperitoneum, mesentery and intestinal wall, and leakage of intraluminal gas through gaps in intestinal mucosa. The first mechanism has been proposed in patients with chronic obstructive lung disease or with other illness of the respiratory system (48). A rise in intraalveolar pressure leads to alveolar rupture and leakage of air into lung interstitium. Air from lung interstitium is thought to dissipate via mediastinum, retroperitoneum and mesenterium into the gut wall (37). The second mechanism is represented by increase of intraluminal bowel pressure, which in connection with damage of the mucosa leads to intramural penetration of gas. This can explain the fact that PCI is often present in patients who have gastrointestinal disease - peptic ulcer disease, Crohn's disease (24,48) or necrotizing enterocolitis (11,27,32). Necrotizing enterocolitis with PCI has been induced experimentally by arterial and lymphatic ligation (46). Some others (41) explain PCI as a consequence of reparation after bowel ischemia.

Bacterial theory

Bacterial theory explains the pathogenesis of PCI by bacterial infection. This infection either damages the intestinal wall with subsequent intramural penetration of gas, or produces gas, which then penetrates into the gut wall. Gas can also enter the lymphatic vessels and cause their dilatation. This theory is supported by experiments in rats, where PCI was induced by Clostridium perfringens (52). The microorganisms playing role in origin of PCI are Clostridium difficile, cytomegalovirus (44) or Clostridium perfringens (7).

Immunopathological inflammatory reaction

Based on observation by Holl et al. (22) and their demonstration of histocytes and foreign-body giant cells present in the afflicted part of the bowel, immunopathological inflammatory reaction has been proposed as a cause of PCI. The presence of monocytes and similar mononuclear cells has been confirmed by Gagliardi et al. (19).
Pneumatosis cystoides intestinalis (PCI) is characterized by the presence of gas-filled cysts in the wall of the colon and occasionally the small intestine. These lesions can be solitary or multiple and are typically asymptomatic. However, they can cause symptoms such as abdominal pain, nausea, and vomiting. The clinical presentation of PCI can be variable and includes gastrointestinal symptoms, perforation, and obstruction. The diagnosis of PCI is often made incidentally during imaging studies. Conservative therapy is usually recommended for asymptomatic patients, while surgical intervention may be necessary for symptomatic cases or when there is evidence of perforation or obstruction.
PC1 after bone marrow transplantation

PC1 has been also described after bone marrow transplantation (6). The effect of long term steroid use, infection, immunosuppression, graft-versus-host disease are thought to cause disorder in these cases (36).

PC1 in connective tissue disease

The increase of PC1 incidence in patients with a connective tissue disease has been observed (2,0,21,30,34). PC1 in these patients is probably caused by damage of the gut wall primarily by this illness or secondary owing to the ischaemia after failure of vessels supply.

Failure of activity hydrogen metabolizing bacteria

PC1 is characterized by high level of breath hydrogen, patients with PC1 excrete more hydrogen than others. Clinical features of PC1 may be in consequence of abnor-

mal hydrogen metabolism. In normal subjects hydrogen is consumed by methane- and sulphate-reducing bacteria. The activity of these bacteria is missing in patients with PC1. This leads to the intraluminal gas accumulation, to an increase of intraluminal pressure and thus to intraluminal gas penetration (12,13). The mechanism just described can explain why a group of patients (35) who excrete the hydrogen hyperproduction is only the initial reason for cysts origin. Their further persistence is caused by nitrogen and oxygen, which diffuse from blood (35).

Clinical presentation

Presence and character of symptoms

The character of symptoms is dependent on the localiza-

PC1 and on presence or non-presence of basic dis-

ease. Symptoms, which can appear, are either non-specific or specific ones. Abdominal distension (29,34), diarrhoea (10,19,29,39), abdominal pain (10,39), constipation (19,39), mural discharge (19,39), hamartomas (34), metal bleeding (19,39), meteorism (14) and weight loss (10) be-

long to non-specific symptoms. Among the specific symp-

ptoms there belong cysts, which can be source of origin of invagination (1) or volvulus (5) and can cause interruption of motility and the mechanical obstruction (26). It is es-

pecially necessary to draw attention to cysts ruptures, which lead to peritonitis – a very serious complication – pneu-

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otomography remains the most successful techni-

que for initial diagnosis and subsequent follow up (17,15). Its disadvantage is high radiation stress and financial seve-

rity. It is also possible to use magnetic resonance in PC1 di-

agnostica (43,44). Furthermore, but less frequently, PC1 can be diagnosed by other ways, as diagnostic laparoscopy (38), endoscopic methods (15,18,34,51) and H2 test, which enables to detect higher breath level of hydrogen by pati-

tients with PC1 (12).

Therapy

In asymptomatic patients with PC1 no special therapy is recommended (9,18). If a basic disease is present, then it is necessary to treat it and secondary cysts regression is usu-

ally observed. PC1 therapy could be conservative or surgi-

cal one.

Conservative therapy

Conservative therapy can be causal or symptomatic. The causal therapy includes ways suppressing supposed etiologi-

tical mechanisms. Inhibition principles of these mecha-

nisms consist either in restriction of intestinal gas producing microflora - administration of antibiotics, es-

pecially metronidazol (7,29,31,47), or in inhibition of pro-

cess leading to the hydrogen hyperproduction - hybercar-

mia or breath hydrogen analysis (7,31,42). In another way of treatment there is possible to include a diet low in flatulence-produ-

cing carbohydrates (14), parenteral nutrition (29), endo-

oscopic therapy (5) or cystsolecitomy (25), therapy with long-acting somatostatin analogue (30). Sympto-

matic therapy suppresses single symptoms (19) - as pain, constipation, diarrhoea.

Surgical therapy

Patients with pneumoperitoneum without signs of peri-

tonal irritation when diagnosis of PC1 is known is not ne-

cessary to operate (23,44), it is sufficient enough to ob-

serve them (23). Surgery is indicated only in fulminating cases (3). The most frequent surgical procedure is gut resec-

tion (7) or limited colostomy (50).

Conclusion

To conclude: pneumatoses cystoides intestines is a rare entity with uncommon recognized by modern diagnos-

tic methods. The practical importance of this paper is to inform about this problem and thus enable to avoid the la-

parotomy in patients suffering from PC1 with pneumoperi-

toneum without signs of peritoneal irritation.

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Introduction

The potential for the exposure to highly toxic organophosphorus compounds (OPs), called nerve agents, exists on the battlefield (e.g. Iran-Iraq war) as well as in a civilian sector as a threat by a terrorist group (e.g. Tokyo subway incident – 12) or as an accident as a part of current demilitarization efforts. OPs elicit their toxic effects by irreversible inhibiting acetylcholinesterase (AChE, EC 3.1.1.7) in the central as well as peripheral nervous system allowing accumulation of acetylcholine (ACh), excessive stimulation of post synaptic cholingeric receptors and consequent signs of neurotoxicity. Signs of acute toxicity with extensive AChE inhibition include autonomic dysfunction (e.g. excessive salivation, lacrimation, urination and defecation), involuntary movements (e.g. tremor, fasciculation), respiratory dysfunction and other signs and symptoms (9, 19).

OP-induced cholingeric effects are usually manifested immediately following high-level exposure (9, 19), nevertheless, there are numerous studies in both humans and animals showing that survivors of high-level OP exposure can experience subtle but significant long-term neurological and neuropsychological outcomes that are detectable months or even years following the recovery from acute poisoning (2). The rapid onset of signs and symptoms of poisoning following OP exposure can be explained in terms of ACh accumulation following AChE inhibition but no mechanism has been identified for the induction of long term effects. In addition, very little is known about possible neurobiological and neuropsychological effects including the impairments of cognitive functions of single or repeated low-level, asymptomatic exposure to OPs. The purpose of this study is to find out whether a nerve agent sarin might cause adverse effects on cognitive functions following the single or repeated low-level inhalation exposure in rats.

Material and methods

Male albino Wistar rats weighing 180-200 g were purchased from VÚFB Konárovice (Czech Republic). They were kept in an air-conditioned room and allowed access to standard food and tap water ad libitum. The rats were divi- ded into groups of ten. Handling of the experimental animals was done under supervision of the Ethics Committee of the Medical Faculty of Charles University and the Purkyně Military Medical Academy in Hradec Králové (Czech Republic).

The rats were exposed to various low concentrations of sarin (obtained from Military Technical Institute, Zemianské Kostolany, Slovak Republic) for 60 minutes in the inhalation chamber. Three low concentrations of sarin were chosen: LEVEL 1–3

Summary: 1. To study the influence of low-level sarin exposure on cognitive functions, male albino Wistar rats were exposed to three various low concentrations of sarin (LEVEL 1–3) for 60 minutes in the inhalation chamber. Testing of cognitive functions was carried out using the T-maze evaluating learning and spatial memory. The behavior of sarin-exposed rats in the T-maze was tested several times within five weeks following sarin inhalation exposure to look for any cognitive impairments. The alteration of cognition was evaluated by using a method studying memory elicitation in response to appetitive motivation in a multiple T-maze. 2. Statistically significant, short-term deficiency in the T-maze performance was observed in rats exposed to symptomatic (LEVEL 3) as well as clinically asymptomatic concentration (LEVEL 2) of sarin. The repeated exposure of rats to clinically asymptomatic dose of sarin (LEVEL 2R) did not change the effect of low-level sarin exposure on spatial memory compared to the single exposure to the same dose of sarin. 3. Thus, sarin is able to influence the cognitive functions (e.g. spatial memory) even at low doses that do not cause clinically manifested intoxication following the inhalation exposure. Nevertheless, the alteration of spatial memory lasts for a short time only, in contrast with the severe sarin poisoning.

Key words: Sarin; Low-level inhalation exposure; Spatial memory; T-maze; Rat