

<http://dx.doi.org/10.35630/2199-885X/2021/11/2/7>

BACTERIAL SYMBIOSIS IN COMPLICATED ULCERS: THE PATHOGENETIC HYPOTHESIS

Received 19 April 2021;
Received in revised form 21 May 2021;
Accepted 26 May 2021

Andrew Martusevich¹ , Gulnar Orudzhova¹ ,
Anastasia Romanova² , Oksana Shubina¹

Aim of this paper:

to estimate crystallogenic properties of gastric mucosa in connection with its microbial contamination.

¹ Privolzhsky Research Medical University, Nizhny Novgorod;

² Kirov State Medical University, Kirov, Russia

✉ cryst-mart@yandex.ru

ABSTRACT — Aim of this paper is to estimate crystallogenic properties of gastric mucosa in connection with its microbial contamination. We investigated crystallogenic properties of some biological substrata (gastric mucosa, gastric mucosal layer homogenates) in 12 healthy individuals and 30 patients with ulcer disease complicated in 12 cases by perforation, bleeding or penetration. Biological substrata were received at fibrogastroduodenoscopy. Estimation of crystallogenic properties of biological material was accomplished by classic crystalloscopy. Biological substrata crystalloscopic investigation was accompanied by its traditional microbiological study for *Helicobacter pylori* and detection of other microorganisms. Our data allow to suppose dual contamination of stomach mucosa both by *Helicobacter pylori* and *Providencia* or *Morganella*. This combination caused elevation of gastric mucosa crystallogenic properties that provoked formation of ulcer. Procrystallogenic potential of this symbiosis may be an important link to the pathogenesis of ulcer disease which realized through microorganism-associated mucosal damage and the progression of complications.

KEYWORDS — ulcer disease, microbe-associated crystallogenesis, *Helicobacter pylori*, *Providencia*, *Morganella*.

INTRODUCTION

Microorganism susceptibility to crystallization was stated long ago. So, it was shown by V.F. Chubukov (1982), that bacteria can form many variants of crystal and pseudocrystal structures [1]. These data was confirmed by other investigators [2, 3, 5, 6]. We named illustrated phenomenon as «microorganism-associated crystallogenesis» (MAC). In our opinion, it has number of functions, such as protective, pathogenic etc [2, 3, 5]. Literature data analysis has shown, that in natural conditions a protective function of MAC is dominated, and a pathogenic function realizes at bacterial antagonism or infection process [2].

Special variant of MAC is the bacterial symbiosis with a high crystallogenic activity. Example of this symbiosis is microbial induced film-formation in catheters.

MATERIAL AND METHODS

We investigated crystallogenic properties of some biological substrata (gastric mucosa, gastric mucosal layer homogenates) in 12 healthy individuals and 30 patients with ulcer disease, among them 12 patients with ulcer complicated by perforation, bleeding or penetration. Biological substrata were obtained using fibrogastroduodenoscopy.

Estimation of crystallogenic and initiated properties of biological material was accomplished by own methods (classic crystalloscopy and comparative teziography [4]). We used 0,9% sodium chloride solution as basic substance in teziographic test.

Biological substrata crystalloscopic investigation was accompanied by its traditional microbiological study for *Helicobacter pylori* (Hp) or/and other microorganisms detection.

Statistical processing of the results was performed using variation statistics algorithms using Microsoft Excel 2007 and Statistica 6.1 for Windows.

RESULTS

Investigation of own and initiated crystallogenesis of gastric mucosa in individuals without gastrointestinal pathology allows to state that in this case biological material has a low crystallogenic activity. At dehydration it mainly formed numerous amorphous structures and single small crystals. In described crystalloscopic picture of gastric mucosa *Helicobacter pylori* was not detected in biological substrate. So, in physiological conditions bacterial flora and gastric mucosa contain bulk mucopolysaccharides [3], have no essential crystallogenic potential and do not promote material initiation of basic substance crystallogenesis in teziographic test (Fig. 1).

On endoscopy, the evidence of gastric ulcer induced by Hp infection, crystallizability and initiation potential of gastric mucosa are meaningfully higher than in healthy people ($p < 0,05$). It manifested as elevation of the portion of crystalloid structures in facia caused by crystallizability rate augmentation. However, this tendency is not accompanied by complication of structural elements (structure index saving at normal level; $p > 0,05$). These changes were

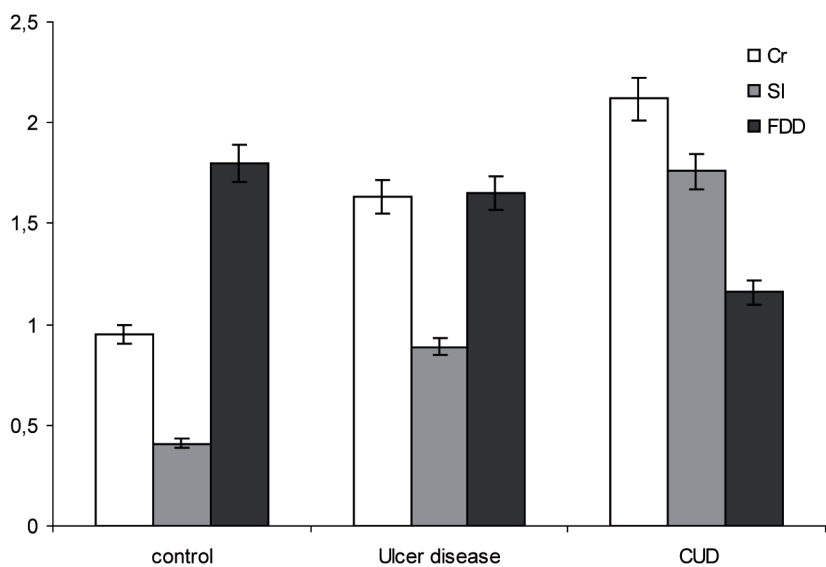


Fig. 1. Visuometric estimation of crystallogenic properties of gastric mucosa (Cr — crystallizability, SI — structure index, FDD — facia destruction degree, CUD — complicated ulcer disease)

corroborated by morphological and morphometric analysis of gastric mucus layers from homogenate mucosal samples. In their facias only single small crystals are presented.

At complicated variants of ulcer disease noticeable activation of crystallogenesis in investigated biological fluids is visualized. So, in this case crystallograms for homogenates of gastric mucosa and gastric mucosal layer include numerous single-crystal elements and dendrites. It caused elevation of crystallizability and structure index level in comparison with healthy people and patients with non-complicated ulcer disease rate. It is interesting, that forming crystals have rather low degree of destruction ($1,42 \pm 0,31$ rel. un.), which can indicate its importance in this pathogenic type of ulcer disease. This tendency is visualized in teziographic facias too. At morphological analysis in homogenates of the gastric mucosal layer, its high crystallogenic properties were discovered. Crystallograms of this biological substrate contained dendrites. It is very important, that at microbiological study in all biological materials *Providencia* or *Morganella* bacteria were marked out in addition to *Hp*. Based on the above consideration we assume that its symbiosis can be an initial factor of the damaged gastric mucosa.

CONCLUSION

Our data allow supposing dual contamination of gastric mucosa both by *Helicobacter pylori* and *Providencia* or *Morganella*. This combination caused elevation of gastric mucosa crystallogenic properties that provoked formation of ulcer. Procrystallogenic potential of this symbiosis may be an important link

to ulcer development, which realized through micro-organism-associated mucosa damage (result of MAC activation) and progression of the complications.

REFERENCES

1. **CHUBUKOV V.F.** Microbes store metals // *Chemistry and life*. – 1982. – Vol. 11. – P. 53–55.
2. **DIEUDONNÉ A., PIGNOL D., PRÉVÉRAL S.** Magnetosomes: biogenic iron nanoparticles produced by environmental bacteria // *Appl Microbiol Biotechnol*. – 2019 Vol. 103, N9. – P. 3637–3649. doi: 10.1007/s00253-019-09728-9.
3. **FAIVRE D., GODEC T.U.** From bacteria to mollusks: the principles underlying the biomineralization of iron oxide materials // *Angew Chem Int Ed Engl*. – 2015. – Vol. 54, N 16. – P. 4728–4747. doi: 10.1002/anie.201408900.
4. **MARTUSEVICH A.K., KAMAKIN N.F.** Unified algorithm for the study of free and initiated crystallogenesis of biological fluids // *Clinical laboratory diagnostics*. – 2007. – No. 6. – P. 21–24.
5. **MCCAUSLAND HC, KOMEILI A.** Magnetic genes: Studying the genetics of biomineralization in magnetotactic bacteria // *PLoS Genet*. – 2020. – Vol. 16, N 2. – e1008499. doi: 10.1371/journal.pgen.1008499.
6. **ZHANG K, XUE Y, ZHANG J, HU X.** Removal of lead from acidic wastewater by bio-mineralized bacteria with pH self-regulation // *Chemosphere*. – 2020. – Vol. 241. – 125041. doi: 10.1016/j.chemosphere.2019.125041.