

The role of probiotics in the process of improvement of patients after arterial repair operations

Agnieszka Wilczyńska^{1, 2}, Katarzyna Korabiusz¹, Agata Wawryków¹,
Martyna Maciejewska¹, Monika Stecko¹, Anna Fabian-Danielewska,
Inga Janik-Fuks

¹ Pomeranian Medical University in Szczecin, Doctoral Studies of the Faculty of Health Sciences, 54 Żołnierska Street, 71-210 Szczecin.

² Pomeranian Medical University in Szczecin, Department of Vascular, General and Angiology Surgery ul. Powstańców Wlkp. 72, 70-111 Szczecin

Keywords: angiology, immunology, lymphatic system, probiotic therapy, microbiota, dysbiosis, intestinal barrier, irritable bowel syndrome, rehabilitation, kinesitherapy, quality of life.

Abstract:

This paper aims to review the literature on the relationship between microbiota and the immune system in terms of the quality of life of patients after arterial repair operations. Angiology is a branch of medicine dealing with vascular diseases of the blood and lymphatic system. As a sub-discipline of surgery, together with techniques of surgical radiology, it has gained high recognition in the medical environment. Despite increasing progress in the process of arterial repair, postoperative complications in the form of swelling of the lower extremities of the operated side are still a problem. This problem concerns about 6% of patients. Another

problem is the risk of vascular transplant infection. The high mortality rate estimated at 9% is worrying. Equally alarming is the percentage of limb amputations at the level of the shin or thigh. It should also be emphasized that the above complications may significantly indicate weakened immunity of patients, thus translating into the slower tissue regeneration process. Even the increasing degree of emotional disturbances as a result of weakened microflora.

Introduction:

Lymphatic dysfunction is associated with inflammation since 1930 (1,2,3). In the general meaning of this term we have to do with the process, which often accompanies surgical procedures. Angiological surgery is a particularly challenging discipline. Most operations performed under particularly clean conditions, yet artificial vascular transplants infect the surgical site. An additional factor is the age of the patients. These are older people, accompanied by coexisting diseases that significantly weaken the immune system. They include hypertension, alcoholism, nicotine disease, diabetes mellitus. Therefore, a thought may suggest a correlation of permanent medication intake (cardiology, NSAIDs, antibiotics), disorders of the structure and function of the intestinal barrier (dysbiosis) (4).

This aspect could be easily associated with irritable bowel syndrome (IBS). Unfortunately, from our observation, it is not taken into account in the process of convalescence after surgery (even more so before) by the team of leading doctors and patients. Repeatedly audible complaints of patients about severe abdominal pain of flatulence and a problem with emptying, alleviated immediately in the consciousness of the disorders as mentioned above will further intensify the problem of dysbiosis. It weakens immune functions in the context of regeneration and inflammatory processes. Another evidence of SIBOS in angiological patients are also CNS disorders (5). It has evidenced by chronic anxiety disorders (loss of limb) and depression. Reduced mental activity significantly translates into physical activity, which in angiological patients is very important due to the activation of vessels transplanted during marching training (kinesitherapy) (6).

Infections of the operated site (SSI)

Infection of the postoperative wound is one of the most common complications after peripheral vascular operations (7): Staphylococcus aureus and coagulase-negative staphylococci. Statistics show both early (within four months after surgery) and late (more than

four months after infection of the transplanted artery). The main reason for artificial vascular transplants, as well as for self-developed veins (8,9). Despite increasing arterial repair progress, this bacterial infection is a factor affecting patient mortality by 11% -27% and amputation frequency (9%) (10,11,12). Appropriate antibiotic therapy is a crucial element in reducing the risk of infection (13). It is a crucial element of treatment element of therapy to save the patient, but it also causes immunological weakness by destroying the patient's natural biofilm (14).

Coexisting diseases:

As the literature indicates, the path to the development of peripheral arterial disorders considered on many levels. The leading causes include hypertension, smoking, alcoholism, diabetes, obesity (15). Many years of taking drugs from the cardiological group and the lifestyle in which we see abuse of stimulants (cigarettes, alcohol) and drugs are a slow process of destruction of the human body, especially at the level of the gastrointestinal tract structure (16,17,18). The authors emphasize, now in its order the effect of treatment is the condition defined as irritable bowel syndrome (IBS). Thus, the SIBOS phenomenon reduces the intestinal blood barrier causing the migration of pathogenic bacteria into the bloodstream and the spread of inflammatory states. This will have a significant effect also in the postoperative period when additional treatment with antibiotics and immunosuppressive drugs further reduces the properties and possibilities of tissue regeneration in the operated area. Prolonged recovery of patients after arterial surgery is an additional risk of prolonged hospitalisation. It can also expose the patient to hospital-acquired infections (19). Thus, the physical and mental state of the patient deteriorates. An important element of rehabilitation after the arterial repair is the fast-motor start of the patient. The ailments i.e. fear and anxiety resulting from the regenerative process, as well as pain in the operated area and coexisting diseases, additionally hinder the healing process. These emotions are also often accompanied by disturbances such as from the central nervous system. Depressive behaviour of the patient, indicating fear of amputation of the operated limb additionally reduces the emotional state and worsens the patient's conscious recovery. The pain of the operated site reduces the willingness to walk. Lack of active marching training may result in rejection of the transplanted vessel by the body and thus increase the risk of amputation of the operated limb.

Summary:

In conclusion, early probiotic therapy would be an excellent complement to the treatment of the patient after surgery. Appropriate use of probiotics would allow to rebuild the

destroyed bacterial flora and thus seal the "intestinal-blood barrier". The immune system, relieved in this way, would increase its activity in the process of regeneration of the place of operated arteries. The reduction of dysbiosis and the growth of its bacterial flora would increase the improvement of serotonin transport, thus alleviating the symptoms of the CNS. Reducing anxiety in patients would translate into positive thinking and thus increase the willingness to implement early rehabilitation services. It would also have an additional impact on the lymphatic system.

Literature:

- 1) Walter Cromer, Ph.D., Wei Wang, M.D., Scott D. Zawieja, B.S., Pierre-Yves von der Weid, Ph.D., M. Karen Newell Rogers, Ph.D., and David C. Zawieja, Ph.D. Department of Medical Physiology, Division of Lymphatic Biology, Texas A&M University Health Science Center College of Medicine, Temple TX USA 76504: Colonic insult impairs lymph flow, increases cellular content of the lymph, alters local lymphatic micro-environment and leads to sustained inflammation in the rat ileum.
- 2) Jeremiah Bernier-Latmani and Tatiana V. Petrova :Intestinal lymphatic vasculature: structure, mechanisms and functions
- 3) Gwendalyn J. Randolph¹, Stoyan Ivanov¹, Bernd H. Zinselmeyer¹ i Joshua P. Washington University School of Medicine, St. Louis, Missouri 631102 University of South Florida, Tampa, Floryda 33612.:The Lymphatic System: Integral Roles in Immunity
- 4) Marlicz W., Łoniewski I., GrimesDS., i wsp. Nonsteroidal anti-inflammatory drugs, proton pump inhibitors and gastrointestinal injury: contrasting interactions in the stomach and small intestine. *Mayo Clin Proc.* 2014;89:1699-709
- 5) Marlicz W., Starzyńska T., Marlicz K.: Pacjent z zespołem jelita nadwrażliwego w praktyce lekarza gastroenterologa. *Polska* 2013; 20: 61-68
- 6) Marlicz W. Wysilek fizyczny a mikroflora przewodu pokarmowego- znaczenie probiotyków w diecie sportowców. *Forum Zaburzenia Metaboliczne.* 2014;5:129-140
- 7) Surgical wound infections after peripheral vascular surgery. *Scand J Surg.* 2014 Dec;103(4):226-31. doi: 10.1177/1457496913514384. Epub 2014 Apr 15.
- 8) Erb S., Sidler JA, Elzi L., Gurke L., Battegay M., Widmer AF, Weisser M. Surgical and antimicrobial treatment of prosthetic vascular graft infections at different surgical sites: a retrospective study of treatment outcomes. *PLoSOne.* 2014;
- 9) Turtiainen J., Hakala T., Hakkarainen T., Karhukorpi J. The impact of surgical wound bacterial colonization on the incidence of surgical site infection after lower limb vascular surgery: a prospective observational study. *Eur. J. Vasc. Endovasc. Surg.*2014;
- 10) Liu SJ, Yin CX, Ding MC, Wang YZ Distribution and drug resistance of pathogens causing surgical incision infections in vascular surgery department. *Chinese Journal of Nosocomiology.*2014; 24 (17):4295–4297
- 11) Neumayer L., Hosokawa P., Itani K., El-Tamer M., Henderson WG, Khuri SF Multivariable predictors of postoperative surgical site infection after general and vascular

surgery: results from the patient safety in surgery study. *J. Am. Coll. Surg.* 2007; 204(6):1178–1187

12) Yong-Gan Zhang, Xue-Li Guo, Yan Song, Chao-Feng Miao, Chuang Zhang, and Ning-Heng Chen: Diagnosis and Treatment of Vascular Surgery Related Infection, Received 2015 May 26; Revised 2015 Jul 14; Accepted 2015 Aug 10.

13) Dethlefsen, L., Huse, S., Sogin, M. L. & Relman, D. A. The pervasive effects of an antibiotic on the human gut microbiota, as revealed by deep 16S rRNA sequencing. *PLoS Biol.* 6, e280 (2008).

14) Frei E, Hodgkiss-Harlow K, Rossi PJ, Edmiston CE Jr.: Microbial pathogenesis of bacterial biofilms: a causative factor of vascular surgical site infection *DF.Vasc Endovascular Surg.* 2011 Nov;45(8):68896.doi:10.1177/1538574411419528.

15) Craig M Walker, Frank T Bunch, Nick G Cavros, Eric J Dippel: Multidisciplinary approach to the diagnosis and management of patients with peripheral arterial disease, *Clin Interv Aging.* 2015; 10: 1147–1153. Published online 2015 Jul 10. doi:10.2147/CIA.S79355

16) Conte MS, Bradbury AW, Kolh P, White JV, Dick F, Fitridge R, Mills JL, Ricco JB, Suresh KR, Murad MH; GVG Writing Group, Aboyans V, Aksoy M, Alexandrescu VA, Armstrong D, Azuma N, Belch J, Bergoeing M, Bjorck M, Chakfé N, Cheng S, Dawson J, Debus ES, Dueck A, Duval S, Eckstein HH, Ferraresi R, Gambhir R, Garguilo M, Geraghty P, Goode S, Gray B, Guo W, Gupta PC, Hinchliffe R, Jetty P, Komori K, Lavery L, Liang W, Lookstein R, Menard M, Misra S, Miyata T, Moneta G, Prado JAM, Munoz A, Paolini JE, Patel M, Pomposelli F, Powell R, Robless P, Rogers L, Schanzer A, Schneider P, Taylor S, Vega De Ceniga M, Veller M, Vermassen F, Wang J, Wang S; Global vascular guidelines on the management of chronic limb-threatening ischemia.

Joint guidelines of the Society for Vascular Surgery; European Society for Vascular Surgery; World Federation of Vascular Societies.

J Vasc Surg. 2019 Jun;69(6S):3S-125S.e40. doi: 10.1016/j.jvs.2019.02.016. Epub 2019 May 28. PMID:31159978

17) Ashkan Farhadi: Intestinal barrier: An interface between health and disease. *Journal of Gastroenterology and Hepatology*, 15 April 2003

18) Walter Cromer, Ph.D., Wei Wang, M.D., Scott D. Zawieja, B.S., Pierre-Yves von der Weid, Ph.D., M. Karen Newell Rogers, Ph.D., and David C. Zawieja, Ph.D.: Colonic insult impairs lymph flow, increases cellular content of the lymph, alters local lymphatic micro-environment and leads to sustained inflammation in the rat ileum. *Inflamm Bowel Dis.* 2015 July ; 21(7): 1553–1563. doi:10.1097/MIB.0000000000000402.

19) Suh J.W., Ju Y., Lee CK., Sohn JW, Kim MJ, Yoon YK.: Molecular epidemiology and clinical significance of *Corynebacterium striatum* isolated from clinical specimens. Jan 4;12:161-171. doi: 10.2147/IDR.S184518. e Collection 2019