ACTA FAC. MED. NAISS. UDK 615.8:616.5

Original article

ACTA FAC. MED. NAISS. 2005; 22 (2): 67-73

Aleksandar Janković,
Milenko Stanojević,
Ivana Binić

Clinic of Dermatovenerology
Clinical Center Niš

EFFECTS OF PHYSICAL THERAPY ON VENOUS ULCER MICROFLORA

SUMMARY

Venous ulcers of the skin are the terminal condition resulting from chronic venous insufficiency and they exclusively appear on previously pathologically altered skin. Disturbed skin structure and altered local environmental conditions are ideal prerequisites for bacterial colonisation onset and infection.

The investigation included 45 patients with venous ulcers treated with electroionic currents (15 patients), polarized light (15 patients), and controls (15 patients). Microflora was determined and controlled on the basis of biogram and antibiogram at the beginning of treatment and in control visits. Physical treatment was conducted every day in duration of 10 minutes. Control group ulcers were not treated with physical therapy.

The type of venous ulcer microflora was established for each group, as well as the impact of each administered treatment.

The type of venous ulcer microflora isolated during the study, sensitivity test and microflora reduction in control check-ups did not demonstrate significant differences among the groups.

The obtained results and their comparison suggest that physical therapy reduces venous ulcer microflora. It reduces bacterial infection, treatment complications and accelerates ulcer healing.

Key words: **venous ulcer, microflora, physical therapy, topical antibiotics**

INTRODUCTION

Numerous scientific debates suggest the importance of bacterial colonization and its role in ulcer infections and their treatment. The role of bacteria in the pathogenesis of chronic venous ulcers is still unresolved. Generally, infections of the skin, soft tissues and ulcers are most commonly induced by gram positive bacteria Staphylococcus aureus and Streptococcus pyogenes (1,2).

Clinical signs of infections are related to the type and amount of ulcer microflora. Within the same ulcer, after the administered treatment and a period of time, alterations of type and number of bacteria in all their relationships are possible. Ulcer size only is not associated with bacteria type and number of micro-organisms. Bacterial colonization is obvious in ulcers with reduced size and surface, too (1,3). Within ulcer microflora there are other numerous aerobic, anaerobic and mixed bacteria: Streptococcus faecalis, Pseudomonas aeruginosa, Enterococcus faecalis, Enterobacter cloacae, Peptococcus magnus, Escherichia coli, Streptococci group D, Peptostreptococcus spp., Bacteroides

fragilis and other (2,4). If bacterial infection does not produce clinical signs of infection, systemic antibiotics are not required, since there is a danger of possible sensibilisation and selection of resistant micro-organism species. The finding of resistant bacterial species is very common after topical antibiotic treatment (5–8).

Nowadays, extensive investigations are conducted in order to find out new therapeutic methods in venous ulcer treatment. In severe, chronic, infected venous ulcers there is a need for additional treatment, most commonly physical (9,10). Physical therapeutic methods represent new, insufficienlty investigated field and they are directly conditioned by science and technology development and their application in medicine.

In recent years, electroionic treatment has been used as a specific and noninvasive treatment of venous ulcers. The method is very efficient when the infection is associated with vascular diseases (11,12).

Polarized light influences vascular structure and improves microcirculation. As a consequence, wound healing and epithelization are improved, especially in case of infections (13,14).

AIMS

The aim of the paper is to identify and determine microbiologic flora before and after the use of electroionic currents, polarized light and topical antibiotics in order to establish the type and treatment effects on microflora reduction.

MATERIAL AND METHODS

The investigation was conducted at the Department of Peripheral Circulation Diseases, Section for Physical Therapy, Clinic of Dermatovenerology, Clinical Center Niš and Public Health Institute.

The study included 45 patients with venous ulcer clinical diagnosis. Patients with different numbers of venous ulcers were randomly divided into 3 groups, with 15 patients each:

- Electroionic treatment group (ER)
- Polarized light treatment group (PL)
- Control group (K)

Microbiologic sampling from the ulcer bottom and vicinity was conducted according to the standard routine. There were 225 microbiologic samples in total (15 patients with 5 microbiologic findings randomized into 3 groups during their treatment). The sampling was done with sterile swab after the regular morning washing of venous ulcers in morning check-ups. Venous ulcer microflora and its susceptibility to antibiotics was determined on admission, after the first, second, third, fifth and seventh treatment week.

Ulcers in group K were not treated with physical therapy. Appropriate day-care and principles of local ulcer therapy, washing and bandaging, use of antiexudative, anti-inflammatory and disinfectious solutions (Sol.: Acidi borici 3%, NaCl 0.9%, Rivanoli 1%, $KMnO_4$ and others) were administered to all groups after the clinical status of ulcers was determined. Use of topical antibiotics (Ung. Chloramphenicol 5%, Gentamycin, Stanicid and others) was based on biogram and antibiogram results or based on the therapeutic range of antibiotics.

Physical therapy in group ER was done with medical apparatus for electroionic treatment indicated for the treatment of venous ulcers and other vascular diseases. Electroionic current treatment and radiation of venous ulcerations was done with electro-medical apparatus manufactured by BIO-EJT SRL, model BE 101, the key features of which are double control of current amount, analogous instruments for separate display of positive and negative currents whose intensities can be adjusted, probe for current-return between the operator and patient, a special quick-connecting system containing the patient cuffs and a stopwatch for the treatment duration setting. The apparatus has the power of 60 W, fusion power 2F 630 mA and 250 V, maximal power 40 kV and 10 μA. It was constructed to withstand cold sterilization and it should not be used in the presence of flammable mixtures containing air, oxygen or nitric oxides. Patients with pacemakers should not be treated with electroionic radiation. Treatment duration was set with automatic stopwatch to be expressed in minutes. One 10- minute treatment per patient was conducted every day. Clean ulceration surfaces, without fat or debris were irradiated.

Physical therapy with polarized light (group PL) was conducted with medical apparatus manufactured by Zepter-Bioptron, Bioptron, model 2, indicated for venous ulcer treatment. The apparatus was constructed for professional use and in accordance with international medical-technical norms. Light emission field is 15 x 15 cm. Light source is a halogen lamp (power 100 W). It is applied from the distance of 10–15 cm, under the right angle, since then the apparatus has the constant power density of 40 mW/cm^2 and constant energy of 2.4 J/cm^2/min. One 10- minute treatment per patient was conducted every day. Clean ulceration surfaces, without fat or debris were irradiated.

The results of the study were systematized, statistically processed and shown in tables.

RESULTS

The microflora findings in group ER were shown in Table 1.

Table 1. Results of microflora assay in group ER

GROUP ER CONTROL CHECK-UPS										
Type of microflor.	WEEKS									
	0		1		3		5		7	
	N^0	%	N^0	%	N^0	%	N^0	%	N^0	%
Pseudo. aerugin.	5	33.33	5	33.33	4	26.66	6	40.00	5	33.33
Staphyl. aureus	10	66.66	11	73.33	8	53.33	5	33.33	7	46.66
Citobacter	1	6.66	-	-	1	6.66	-	-	-	-
Entero. bacter	1	6.66	1	6.66	-	-	1	6.66	-	-
Proteus mirabilis	5	33.33	1	6.66	-	-	-	-	-	-
Esheric. coli	2	13.33	-	-	-	-	1	6.66	-	-
Staphy. sp.	1	6.66	-	-	1	6.66	-	-	-	-
Candida	-	-	1	6.66	-	-	-	-	-	-
Sterilno	-	-	-	-	-	-	2	13.33	2	13.33
No findings	-	-	1	6,66	1	6.66	-	-	1	6.66

There were 7 bacterial types and 1 fungal type. Seven bacterial types were isolated at the beginning of treatment: Pseudomonas aeruginosa in 5 (33.33%), Staphylococcus aureus in 10 (66.66%), Staphylococcus sp. Citrobacter and Enterobacter in 1 (6.66%), Proteus mirabilis in 5 (33.33%), Escherichia coli in 2, and Candida albicans fungus in 1 (6.66%). At the end of the treatment two bacteria were isolated: Pseudomonas aeruginosa in 5 (33.33%), Staphylococcus aureus in 7 (46.66%). There were 2 sterile findings (13.33%) and 1 without findings (6.66%). Ulcerations from which bacteria were isolated did not demonstrate clinical symptoms of infection. Other bacteria isolated at the beginning were not registered at the end of the treatment.

The results of microflora testing in group PL are shown in Table 2.

At the beginning of treatment 7 types of bacteria and 1 type of fungi were isolated. Pseudomonas aeruginosa was isolated in 10 (66.66%), Staphylococcus aureus in 7 (46.66%), Proteus mirabilis in 3 (20.0%), Enterococcus faecalis and Escherichia coli in 2 (13.33%), Staphylococcus epidermidis and Acinetobacter in one (6.66%). Candida albicans was isolated in 1 (6.66%). One finding was sterile. At the end of the treatment 2 bacteria were isolated: Pseudomonas aeruginosa in 3 (20.0%), Staphylococcus aureus in 8 (53.33%). There were 2 (13.33%) sterile findings, as well as 2 findings we were unable to register for technical reasons. Other bacteria isolated at the beginning were not registered at the end of the treatment.

In group K, 6 bacteria types were isolated and 1 fungal type (table 3).

At the beginning of treatment 6 bacteria were isolated: Pseudomonas aeruginosa in 8 (53.33%), Staphylococcus aureus in 6 (40.0%), Escherichia coli in 2 (13.33%), Citrobacter, Enterobacter and Providencia sp. in 1 (6.66%) and fungus Candida albicans in 1 (6.66%). At the end of the treatment 2 bacterial types were isolated: Pseudomonas aeruginosa in 5 (33.33%), Staphylococcus aureus in 8 (53.33%). One finding (6.66%) was sterile. One patient had no findings (6.66%). Ulcerations from which bacteria were isolated did not demonstrate clinical symptoms of infection. Other bacteria isolated at the beginning were not registered at the end of the treatment.

Table 4. shows the total decreased of microflora in the examined groups.

DISCUSSION

Physical therapy is mainly referred to as an accessory treatment method, with certain physical agents the use of which may be useful in venous ulcer treatment. However, up to the present, there have been few studies with a small number of patients, in-

Table 2. Results of microflora assay in group PL

GROUP PL CONTROL CHECK-UPS										
Type of microflor.	W E E K S									
	0		1		3		5		7	
	N^0	%	N^0	%	N^0	%	N^0	%	N^0	%
Pseudo. aerugin.	10	66.0	5	33.33	3	20.0	2	13.33	3	20.0
Staphyl. aureus	7	46.6	9	60.0	12	80.0	10	66.66	8	53.33
Staphyl. epiderm.	1	6.66	-	-	-	-	-	-	-	-
Enteroc. faecalis	2	13.33	-	-	2	13.33	-	-	-	-
Proteus mirabilis	3	20.0	-	-	-	-	1	6.66	-	-
Esheric. coli	2	13.33	1	6.66	-	-	-	-	-	-
Acineto-bacter	1	6.66	-	-	-	-	-	-	-	-
Candida	1	6.66	-	-	-	-	-	-	-	-
Sterilno	1	6.66	1	6.66	-	-	1	6.66	2	13.33
No findings	-	-	-	-	-	-	1	6.66	2	13.33

Table 3. Results of microflora assay in group K

GROUP K CONTROL CHECK-UPS										
Type of microflor.	W E E K S									
	0		1		3		5		7	
	N^0	%	N^0	%	N^0	%	N^0	%	N^0	%
Pseudo. aerugin.	8	53.33	9	60.0	7	46.66	6	40.0	5	33.33
Staphyl. aureus	6	40.0	9	60.0	6	40.0	5	33.33	8	53.33
Citobacter	1	6.66	-	-	-	-	-	-	-	-
Provid. sp.	1	6.66	-	-	-	-	1	6.66	-	-
Esheric. coli	2	13.33	-	-	1	6.66	-	-	-	-
Enterobacter	1	6.66	1	6.66	-	-	1	6.66	-	-
Candida	1	6.66	-	-	-	-	-	-	-	-
Sterilno	-	-	2	13.33	-	-	1	6.66	1	6.66
No findings	-	-	-	-	1	6.66	1	6.66	1	6.66

Table 4. Total decreased of microflroa in the examined groups

GROUP	PL		ER		K	
	Startup	Finish	Startup	Finish	Startup	Finish
Number findings microflora	27	11	25	10	20	13
Increase (%)	59%		60%		35%	

valid for assessment of the real impact of administered physical therapy (15,16). On the basis on the investigations so far, it is very difficult to draw conclusions on their special effects on venous ulcers.

Our results are comparable with the literature data on the general incidence of venous ulcer microflora (1,15,17,20-23). Certain findings demonstrated the presence of more than one bacteria type in venous ulcers, i.e. combined bacterial colonization, the analysis of which we have not performed here. The obtained results were compared and we did not observe significant variations in microflora reduction. Reduced number of certain bacteria findings (Pseudomonas aeruginosa) and increased number of others (Staphylococcus aureus) compared to treatment onset, as well as findings which did not isolate bacteria compared to treatment onset (Citrobacter, Providencia sp., Escherichia coli) and fungi (Candida albicans) is approximately the same when all studied groups are compared. Staphylococcus aureus frequently colonizes healthy skin as well, while Pseudomonas aeruginosa induces opportunistic infections and intrahospital infections resistant to the tetreatment (1,5,17–19,22). We have not found any data on comparison of physical treatment effects on the type of venous ulcer microflora. That is the reason why we believe that our data are interesting for further studies of similar effects of electroionic currents and polarized light on venous ulcer microflora.

Microbiologic results should be reconsidered from the viewpoint of appropriate bandage material using. Venous ulcers can be bandaged with adequate non-sterile bandage material. In the literature, the importance of bacterial colonization is stressed, as well as the role of bacteria in ulcers with objectively reduced size and surface. Bacterial flora, with minor qualitative differences, is the same in ulcers of different epidemiology. Every venous ulceration is colonised by bacteria. They can provoke infection, increase exudation level, worsen the clinical status and prolong adequate treatment and epithelization. The finding of resistant bacterial species is quite common after topical antibiotics (1,17,18,23). Presence of bacteria not causing inflammation signs does not have unfavourable effects on ulcer healing. Neglected-looking ulcer is not necessarily an infected ulcer (1,3,21,22). Clinical status of a venous ulcer should be monitored regularly in hospitals, as well as its vicinity, with special attention paid to the parameters suggesting possible infection (erythema, maceration, desquamation, exudation, fibrin deposits, pain and itching). In cases of manifest infection systemic antibiotics should be applied on the basis of susceptibility tests - antibiogram. Venous ulcer treatment with topical antibiotics has been abandoned since these cannot stimulate healing and on account of possible complications - over-sensitivity and bacterial resistance to the applied antibiotic (1,15,17,18,20).

In more than 50% of venous ulcers anaerobic bacteria can be isolated by cultivation. Seeding and cultivation of the material from ulcer bottom usually indicates the presence of Staphylococcus aureus and numerous aerobic gram-bacteria, most commonly at the same time. Other numerous aerobic, anaerobic and mixed-type bacteria (Staphylococcus aureus, Streptococcus faecalis, Pseudomonas aeruginosa, Enterococcus faecalis, Escherichia coli and others (1,15,21–23). Specific treatment of ulcers colonized by Pseudomonas aeruginosa is still debated over. Findings of fungi on ulcers is also important (21,22). In patients treated with different therapeutic approaches positive findings of Candida albicans cultivation may be encountered. Candida albicans is present around the ulceration, and it may be recognized as a network structure on the fingers of lower extremities in the immediate vicinity of ulcer. Clinical signs of manifest infection around ulcer are erythema, pustulas and skin erosions. Fungi may irritate ulcer vicinity and increase pain. Candida albicans can be found at the ulcer site due to topical antibiotic treatment (21–23).

Cultivation of the causative agent of an infection is not always necessary. The influence of these micro-organisms could probably be disregarded till the first signs of infection occur. The information on the type of bacterial flora is useful since empirical antibiotic treatment can alter susceptibilty tests and causative agent cultivation (1,3,5).

If bacterial colonisation does not induce clinical signs of infection, it is not necessary to apply systemic antibiotics - there is a danger of potential sensibilization and selection of resistant micro-organism species (1,3,5,15,19).

Quantitative determination of microflora is mentioned in the literature, where the number of bacteria over the cut-off value of 10^5–10^6 per gram of tissue in ml of exudate is a risk factor so that bacterial colonization may lead to clinical infection signs (1,18,19,23). Since such a method is not applied in our situation, we are unable to present such results. In order to completely evaluate the effects of physical treatment methods on bacterial flora used in ulcer management, comparisons with other mentioned methods for microflora determination is required.

CONCLUSION

On the basis of our results, it may be concluded that electroionic currents and polarized light can qualitatively reduce microbiologic flora during venous ulcer treatment. Reduced bacterial colonization under the action of used physical agents can reduce the risk of infection as a treatment complication. Our results confirm the microbiologic efficacy of electroionic currents and polarized light in venous ulcer treatment.

REFERENCES

1. Gunnel E. Leg Ulcers Diagnosis and Treatment. Promotion& Publishing Support, Astra Arcus AB, Sweden 1994; 22-38.

2. Gilchrist B, Reed C. The bacteriology of chronic venous ulcers treated with occlusive hydrocolloid dressings. Br J Dermatol 1989; 121: 337-44.

3. Bowler PG, Duerden BI, Armstrong DG. Wound microbiology and associated approaches to wound management. Clin Microbiol Rev 2001; 14: 244-69.

4. Karadaglić Đ, Kandolf Lj. Kožne promene u oboljenjima perifernih krvnih sudova. In: Karadaglić Đ. ur. Dermatovenerologija. Vojnoizdavački zavod-Verzalpress, Beograd 2000; 1616-39.

5. De Leo C. Cappotto F, Somma MC, Tagliero A, Fusco A. Micro-organisms isolated from infected ulcers of lower extremity and their antibiotic sensitivity patterns. JEADV 1999; 12 (Supp 2): 217.

6. Palolathti M, Lauharanta J, Stephens RW, Kuusela P, Vaheri A. Proteolitic activity in leg ulcer exudate. Exp Dermatol 1993; 2: 29-37.

7. Eriksson F, Eklund A, Kallings LO. The clinical significance of bacterial growth in venous leg ulcers. Scand J Infect Dis 1984; 16: 175-90.

8. Kulozik M. Powel S, Cherry GW, Ryan TJ. Contact sensitivity in community-based leg clinics. Clin Exp Dermatol 1988; 13: 82-4.

9. Knajter I, Dostanić I, Ljuština M, Isakov B. Fizikalna terapija u dermatologiji i kozmetici. Medicina Jugoslavica. Beograd 1991; 9-13: 60-2.

10. Junger M, Steins A, Zuder D, Klyscz T. Physical therapy of venous diseases. Vasa 1998; 27: 73-9.

11. Palmeri F, Savojardo M, Pecorella G, Lo Coco L, Francavilla G. Valutazione Sulla applicazione del BIO-EJT in traumatologia da sport. Med Clin Term 1998; 44-45: 139-51.

12. Ancona E. Valutazione dell'effetto dell' aplicazione del BIOEJT sulle ulcere venose. Padova, 1997.

13. Hass HL. The therapeutic activity of the BIOPTRON- lamp in the treatment of disorders of wound healing. Diabetic gangrene. Krankepfl J. 1998; 36: 494-6.

14. Hass HL. Therapeutic potentials of the Bioptron light: treatment of disorders in wound healing. Krankepfl J 1998; 36: 451-3.

15. Schmidt K, Debus ES, St Jessberger, Ziegler U, Thiede A. Bacterial population of chronic crural ulcers: is there a difference between the diabetic, the venous, and the arterial ulcer? Vasa 2000; 29: 62-70.

16. Bowler PG, Duerden BI, Armstrong DG. Wound microbiology and associated approaches to wound management. Clin Microbiol Rev 2001; 14: 244-69.

17. Kotilainen P, Huovien S, Jarvinen H, Aro H, Huovinen P. Epidemiology of the colonization of inpatients and outpatients with ciprofloxacin-resistant coagulase-negative staphylococci. Clin Infect Dis 1995; 21: 685-7.

18. Roghmann MC, Siddiqui A, Plaisance K, Standiford H. MRSA colonization and the risk of MRSA bacteraemia in hospitalized patients with chronic ulcers. J Hosp Infect 2001; 47: 98-103.

19. Danielsen L, Balslev E, Doring G, Hoiby N, Madsen SM, Agren M, Thomsen HK, Fos HH, Westh H. Ulcer bed infection. Report of a case enlarging venous leg ulcer colonized by Pseudomonas aeruginosa. AAPMIS 1998; 106: 721-6.

20. Danielson L, Cherry GW, Harding K, Rollman O. Cadexomer iodine in ulcers colonized by Pseudomonas aeruginosa. J Wound Care 1997; 6: 169-72.

21. Hanson C, Faergeamann J, Swanbeck E. Fungal infections occuring under bandages in leg ulcer patients. Acta Dermatol Venereol 1987; 67: 341-5.

22. Dorko E, Kmetova M, Pilipinec E, Bracokova I, Dorko F, Danko J, Svicky E, Tkacikova L. Rare non-albicans Candida species detected in different clinical diagnoses. Folia Microbiol 2000; 45: 364-8.

23. Bendy RH, Nuccio P, Wolfe E. Relationship of quantitative wound bacterial counts to healing of decubitis: effect of topical gentamicin. Antimicrob Agents Chemother 1964; 4: 147-55.

UTICAJ FIZIKALNE TERAPIJE NA MIKROFLORU VENSKIH ULKUSA

Aleksandar Janković, Milenko Stanojević, Ivana Binić

Klinika za dermatovenerologiju, KC Niš

SAŽETAK

Venski ulkusi potkolenice predstavljaju krajnje posledično stanje hronične venske insuficijencije i pojavljuju se samo na prethodno patološki izmenjenoj koži. Narušena struktura kože i promenjeni uslovi spoljašnje sredine stvaraju idealne uslove za početak bakterijske kolonizacije i infekcije.

Ispitivanjem je ukupno obuhvaćeno 45 bolesnika sa venskim ulkusima koji su lečeni elektrojonskim strujama (15 bolesnika), polarizovanom svetlošću (15 bolesnika) i kontrolna grupa (15 bolesnika). Mikroflora je određivana i kontrolisana na osnovu biograma i anti-

biograma, na početku terapije i kontrolnim pregledima. Fizikalni tretman je sprovođen svakodnevno u trajanju od 10 minuta. Ulceracije u kontrolnoj grupi nisu tretirane fizikalnom terapijom.

Istraživanjem je utvrđena vrsta mikroflore venskih ulkusa po grupama kao i uticaj svakog primenjenog tretmana.

Vrsta mikroflore koja je tokom ispitivanja izolovana, test osetljivosti i smanjenje mikroflore na kontrolnim pregledima, ne pokazuju bitne i značajne razlike unutar grupa.

Dobijeni rezultati i njihovo poređenje govore da fizikalna terapija smanjuje vrstu mikroflore venskih ulkusa. Upotreba fizikalne terapije smanjuje bakterijsku infekciju, komplikacije lečenja i omogućava brže zarastanje ulkusa.

Ključne reči: **venski ulkusi, mikroflora, fizikalna terapija, topijski antibiotici**