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Treatment of Chronic Leg Ulcers with a Hydrocolloid Dressing

By

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Gamborg Nielsen P, Munk Madsen S, Strömberg L. Treatment of chronic leg ulcers with a hydrocolloid dressing. Acta Derm Venereol (Stockh) 1990.

The effects of a hydrocolloid dressing (Comfeel Ulcus®) on the physical environment of chronic leg ulcers in 58 consecutive out-patients were investigated. Patients were subdivided into two groups of which Group 1 included 31 (53.4%) and Group 2, 27 (46.6%) patients. Twenty-three (39.7%) patients healed within 7 weeks (study period) and 49 (84.5%) within 1 year (follow-up period). Aerobic and anaerobic bacterial cultures as well as mycotic cultures were performed from ulcer bases of both groups of patients. In Group 1 a 3 mm punch biopsy was taken from the ulcer margins for histopathological examination. In Group 2 serum levels of iron, zinc, copper and selenium were measured and in these latter patients a mean temperature difference of 2.8°C between the ulcer base and the skin surrounding the ulcer was found. There was no difference in ulcer pH in patients belonging to Group 2, independent of bacterial or fungal contamination. Low serum iron was found in 74.1% and anaemia in 40.7% of the patients in Group 2. No differences in ulcer healing were seen in these patients compared with those without iron-deficiency or anaemia. No differences were seen in serum iron, zinc, copper or selenium levels between good and poor healers. There were 22.2% ulcer relapses in Group 1 within a year of the start of the study, with no relapses in those 15 patients of Group 2 who used specially designed compression stockings.

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INTRODUCTION

Chronic leg ulcers are a common cause of patient morbidity and their treatment incurs significant direct and indirect costs. The prevalence of chronic leg ulcers has been estimated to 0.32% of the total population and to 0.46% of a population over 25 years of age (1). The average age in larger materials appears to be between 70 and 80 years of age, and 60% is women. The distribution of chronic leg ulcers according to their etiology has recently been reported to venous ulcers 75%, arterial ulcers 8%, mixed arterial and venous ulcers 17% and ulcers of other genesis 1% (2).

Hydrocolloid dressings

During the last decade different types of hydrocolloid dressings have been used as adjuvants in the wound healing process (3). Occlusion has been shown to alter the microenvironment of wounds and increases reepithelialization (4, 5). Survival and proper function of cells appears to be secondary to increased moisture under occlusion, which allows epithelial migration to take place without impedance by thicker scab formation found in wounds exposed to air (6, 7) (Fig. 1). Hydrocolloid dressings have also the ability of decreasing subjective pain to the patient. Each dressing has different characteristics and chemical compositions with different adhesive properties, degrees of wound dehydration and permeabilities to water, oxygen, carbon dioxide and bacterial products (8). Permeability of oxygen and the role of pO_2 in the healing process, however, is not clearly understood. Rapid reepithelialisation has been reported when pO_2 is raised and when wounds are treated with oxygen-permeable dressings. Reduced pO_2 promotes in vitro growth of fibroblasts and production of angiogenesis factors from tissue macrophages (9). Such observations may lead to the belief that a low, rather than high, pO_2 enhances the healing process. However, clinical differences in the healing rate of chronic leg ulcers treated with semipermeable hydrocolloid dressings or occlusive hydrocolloid dressings has not yet been reported (10). Comfeel Ulcus® belongs to the group of semiocclusive hydrocolloid dressings and does not contain chemical additives which may influence the microenvironment of wounds.

Microbiology

Chronic leg ulcers generally harbour a mixed bacterial flora, the most common species being *Staphylococcus aureus,* hemolytic streptococci and *Pseudomonas aeruginosa* (11). The remaining aerobic bacteria vary in published materials. Anaerobic bacteria are seldom isolated from chronic leg ulcers, mostly owing to relatively complicated procedures, but generally they comprise 5–10% of isolates (12). Candida species have been reported to be isolated in 20–39% of chronic leg ulcers, and improvement of ulcer evolution was found when they were eradicated (1, 13, 14).

Hydrocolloid dressings provide physical barriers to exogenous microorganisms, but do not have the capability of staving off infection once a pathogen is introduced. Quantitative cultures are seldom available in clinical practice. However, failure of healing has been shown in chronic leg ulcers with more than 10^5 bacteria per gram (15). Symptoms of clinical infection hence give quidance to when systemic antibiotics should be prescribed. No unique bacteria are associated with these dressings and they are incapable of minimizing infection caused by the most common microorganisms found in chronic leg ulcers.

Histopathology

Histopathologic examination of wounds is important in patients with chronic leg ulcers of abnormal localization and long duration. Malignant change is exceedingly rare, 3 cases of squamous carcinoma in 2000 ulcers have been reported, but an increasing number of ulcers caused by cutaneous vasculitis have been published during the last few decades (16).

Biochemistry

Proper wound healing is dependent on the host's ability to mount a normal inflammatory response. It is therefore not surprising that nutritional and immunological deficiencies are likely to interfere with healing. Nutritional deficiencies may be more common in the elderly and are suggested by a low serum albumin or transferring level (17). Reduced iron in serum and anaemia is generally found in old age. The specific role of zinc concerning wound healing is still unclear, but during the last two decades, patients with chronic leg ulcers combined with a zinc deficiency have been

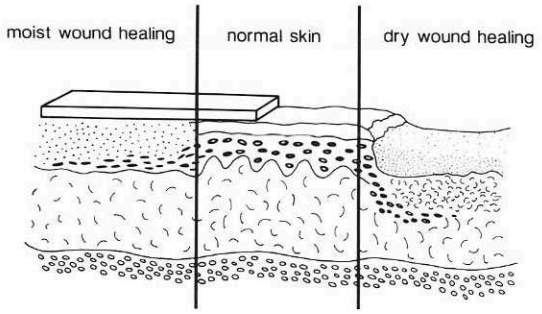

Fig. 1. Outline of dry and moist wound healing respectively, modified after G. D. Winter (Staffan Nygren, Department of Medical Photography, Central Hospital, Boden, Sweden).

treated with perorally administered zinc to enhance healing rate (18, 19). It is, however, not unlikely that patients with low zinc level in serum have other dietary deficiencies and metabolic problems which may retard wound healing. It has recently been shown, that total serum zinc level reflects serum albumin concentration (20). It is, therefore, most likely that dietary deficiency influences healing, and that successful ulcer evolution is dependent on adequate nutritional stores provided by a balanced diet of protein, carbohydrates, fat, vitamins and minerals.

It was recently published that levels of selenium, iron and zinc were significantly lower and the copper/zinc ratio significantly higher in patients with chronic leg ulcers in comparison with control patients. Serum copper level and copper/zinc ratio were also higher in patients showing poor ulcer healing (21).

pH and temperature of the wound base influence oxygen release and growth of certain microorganisms. pH of the wound base of chronic leg ulcers was measured to be 7.7 (range 7.3–8.9) (22). Prolonged acidification of the ulcer surface increases oxygen release, whereas alkalinization lowers the oxygen tension. A beneficial effect on healing rate has been claimed when continuous acidification is used. Moist dressings consisting of 1 % acetic acid remain acid for only one hour at which time pH rises to neutrality (23, 24). Acidification by different polycarboxylated jellies has been tested, resulting in prolonged lowered pH of the wound base (23). A low tissue temperature of the ulcer surface has been shown to hamper healing, probably, among other factors, by causing a decrease in oxygen release (25). A temperature of the occluded wound, corresponding to the tissue temperature of the affected region has been shown to provide better conditions for repair of ulcers independent of oxygen release (26, 27).

Contact allergy

Positive patch tests have been shown to occur 5–6 times more often among patients with chronic leg ulcers and hypostatic eczema, than among other dermatological patients (28). Patients with chronic leg ulcers become easily sensitized to topically applied substances in creams and ointments and to preservatives, which generally vary depending on national or regional use. Neomycin, framycetin, colophony, balsam of Peru and parabenes are common everywhere.

Compression treatment

For treatment of venous leg ulcers, compression bandages are known to be effective. The generally quoted theoretically calculated optimal pressure of bandages ranges from 30–40 mmHg (29). Relapse rate during the first year has been reported to be 40–60 % and compression is necessary for years after healing to prevent new leg ulcers.

MATERIAL AND METHODS

Fifty-eight consecutive out-patients, 43 women and 15 men, average age 74 years (range 37–88 years) with chronic leg ulcers of average duration 7.7 years (range 9 months – 49 years) were enlisted in the study, which took place in a hospital dermatological department during 1987 and 1988. Patients were assigned at random into two groups. Group 1 included 31 patients, 24 women and 7 men, average age 75 years (range 37–85 years) and an average duration of wounds of 9.5 years (range 9 months – 49 years). Group 2 included 27 patients, 19 women and 8 men, average age 75 years (range 56–88 years) with an average ulcer duration of 5.6 years (range 9 months – 48 years).

The leg ulcers were classified into four etiological categories on the basis of a standardized examination which included enquiry into history of deep venous thrombosis of the affected limb, the presence of varicose veins, obesity, hypertension, diabetes mellitus, arteriosclerosis or the presence of non-cardiac oedema. The etiological categories were: venous ulcers, arterial ulcers, mixed venous and arterial ulcers and ulcers of other genesis.

The observation period was limited to seven weeks, irrespective of whether or not complete healing was achieved within that time. Patients were, however, followed up until complete re-epithelialization had

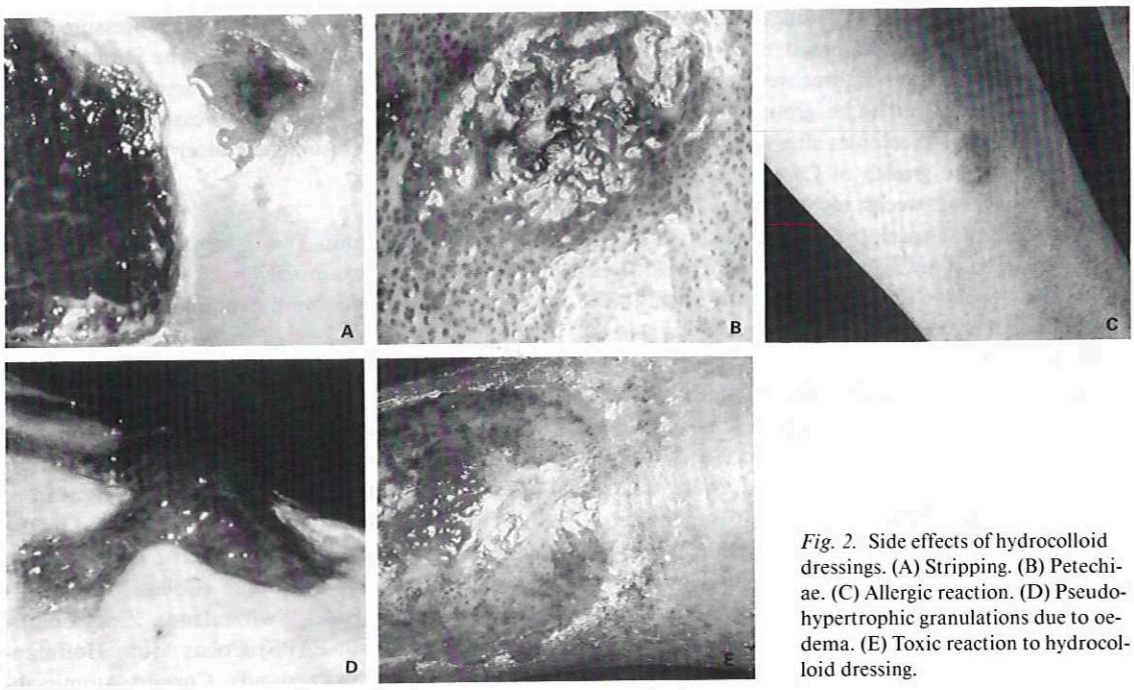

Fig. 2. Side effects of hydrocolloid dressings. (A) Stripping. (B) Petechiae. (C) Allergic reaction. (D) Pseudohypertrophic granulations due to oedema. (E) Toxic reaction to hydrocolloid dressing.

occurred or at least for 1 year (follow-up period). Patients were examined at weekly intervals and dressing changes were performed by one single nurse. At each clinic visit, ulcers were assessed by tracing the outline onto transparent film. After the study was closed, areas were calculated by planimetry, and expressed in square centimeters. The depth of the ulcers was graded from 1–3, grade 1 being superficial, grade 2 medium depth and grade 3 deep ulcers.

Before patients entered the study, a patch test against Comfeel Ulcus® was performed according to the recommendations of the International Contact Dermatitis Research Group (ICDRG). Toxic reactions to dressings or other side effects and pain was assessed on a linear analogue scale. At each patient's first visit to the clinic, a surgical wound debridement was carried out, after the ulcer base had been anaesthetised with EMLA cream (Astra Pharmaceuticals, Södertälje, Sweden), an oil/water emulsion of equal amounts of lidocaine and prilocaine 25 mg, which was left on the ulcer for 30 min under occlusion with household plastic film (30). Even though EMLA cream is still not recommended for anasthesia of leg ulcers, it is generally prescribed for that use. Allergic reactions have not yet been reported and maximum plasma concentrations have been shown to be low. It was, therefore, considered safe to use this method for cleansing wounds. Black necroses were removed with scissors and tweezers, and yellow necroses by curettage. Enzymatic agents were not used for ulcer cleansing.

Hydrocolloid dressing

A commercially available hydrocolloid dressing (Comfeel Ulcus®, A/S Coloplast, Espergaerde, Denmark) was consistently used during the study and the follow–up period. Dressings were cut out to cover the ulcer and an approximately 2 cm wide skin border around it. To prevent side effects, such as stripping, petechiae, irritant reactions (Fig. 2) and maceration, and to improve healing, 40% zinc oxide paste was applied to the surrounding skin before the hydrocolloid dressing was attached (31, 32).

Microbiology

From 58 ulcers (Group 1 and Group 2) qualitative aerobic bacterial cultures and semiquantitative fungal cultures were taken at the first clinic visit and after various periods of occlusion. Anaerobic qualitative bacterial cultures were taken from the ulcer base with a 3 mm punch biopsy at the first visit to the clinic. Isolation of aerobic and anaerobic bacteria followed generally accepted bacteriological principles. Candida species were identified by inoculation on Sabour-

aud's glucose agar without cycloheximide, incubated at 27°C. Dishes were examined once a week and discarded after a period of three weeks. Candida species were divided into three groups: 1) Growth of Candida species: 1–5 colonies after 2–3 weeks incubation. 2) Moderate growth of Candida species: 6–10 colonies after 1–2 weeks incubation. 3) Abundant growth of Candida species: > 10 colonies in less than 1 week's incubation. Groups 1 and 2 were considered to indicate saprophytic growth and only when there was abundant growth (Group 3) infection was said to be present (33).

Patients with ulcers that showed clinical signs of infection (cellulitis, secretion, pain and impaired healing) and from which *Staphylococcus aureus* or hemolytic streptococci were isolated, were treated with systemic antibiotics for 1 week. The choice of antibiotics was determined by the results of resistance-testing performed at the previous clinic visit. Ulcers from which *Pseudomonas aeruginosa* was isolated were treated with 1 % acetic acid jelly (sodium carboxymethylcellulose 34 g, glycerol 100 g, glacial acetic acid 7.5 g (pH 3.4) and distilled water ad 1 000 g. Design: P. Gamborg Nielsen & S. Munk Madsen, 1987) as long as positive cultures were determined (34).

Those from whom anaerobic bacteria were cultured were treated with 1 % metronidazole jelly (metronidazole 10 g, sodium carboxymethylcellulose 34 g, glycerol 100 g, lactic acid 90% to pH 3.4 (app. 11 g) and distilled water ad 1 000 g. Design: P. Gamborg Nielsen & S. Munk Madsen, 1987). Jellies were applied to the wound bases at each clinic visit and covered with the hydrocolloid dressing. For ethical reasons, repeat biopsies for culture of anaerobic bacteria were not made and, therefore, 1 % metronidazole jelly was applied during the entire study (7 weeks). Treatment effect on ulcers from which anaerobic bacteria were cultured was assessed only by their healing rate in comparison with that of the remaining ulcers.

Ulcers with clinical signs of yeast infection and abundant growth of Candida species were treated with 1 % econazole nitrate jelly (econazole nitrate 10 g, sodium carboxymethylcellulose 34 g, glycerol 100 g, lactic acid 90% to pH 4.0 and distilled water ad 1 000 g. Design: P. Gamborg Nielsen & S. Munk Madsen, 1987) and occluded as above (35).

Compression treatment

In addition all affected legs were bandaged with an elastic support bandage (Dauerbinde®, Lohmann GmbH & Co KG, Neuwied, FRG) at a pressure tolerable to the patients (36). During the study period, some of the patients developed pseudohypertrophic granulations (Fig. 2) which were easily treated by an increase of the pressure on the ulcer region.

Histopathology

In 31 patients (Group 1) a 3 mm punch biopsy for histopathological examination was taken from the wound border. Slides were examined by a dermatopathologist.

Biochemistry

Haemoglobin level, serum iron, and serum albumin were measured in 27 patients (Group 2) at the start of the study and at its completion. Serum levels of iron, zinc, copper and selenium were also measured by the following methods: Iron: Colorimetric method using a guanidine/ferrizine technique (Cobas Mira, Hoffmann- La Roche, Basel, Switzerland). Zinc: Colorimetric method (5-Br-PAPS) Cobas Mira, Hoffman-La Roche, Basel, Switzerland). Copper: Atomic-absorption spectrophotometric method using a graphite oven technique (Perkin Elmer model 111 B, Perkin Elmer Corp., Norwalk, Connecticut, USA). Selenium: Fluorimetric technique according to La Londe (37). Results were compared with those from age and sex-matched control patients admitted to the laboratory in connection with general health checks. The serum copper level and the serum copper/zinc ratio was calculated in patients with less than 50% reduction of ulcer areas (poor healers) and compared to those with more than 50% reduction (good healers).

pH and temperature

At each clinic visit, the pH of the ulcer bases, before and after occlusion and of the adjacent skin in the same 27 patients (Group 2) was measured using a Beckman 60 pH meter (Beckman Instruments, Fullerton, California, USA) with a Beckman plane electrode (No 39523-S-608 B) which was calibrated at pH 4 and 7.

In the same group of patients the temperature of the wound base before and after occlusion with hydrocolloid dressings was compared to that of adjacent skin, using a medical precision thermometer DM 852 (Ellab, Copenhagen, Denmark) with two different probes. Temperature at the base of the ulcer was measured before removing the old hydrocolloid dressing with a filiform probe inserted into a hypodermic needle, while that of the surrounding skin was meas-

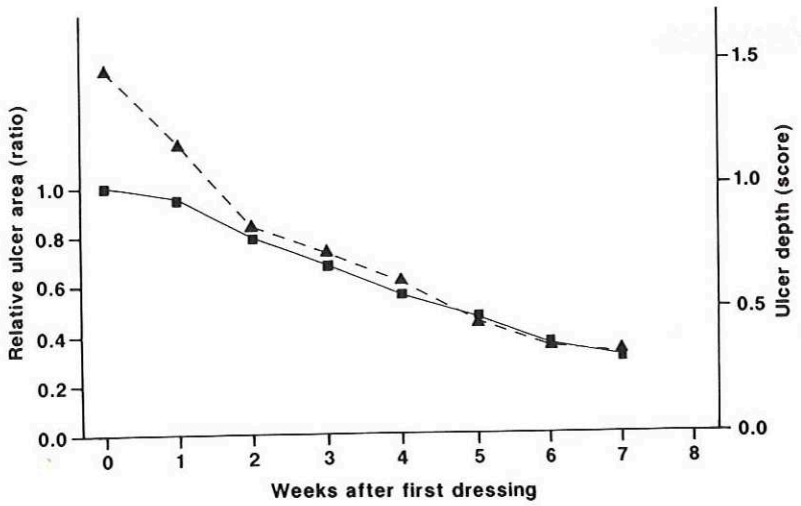

Fig. 3. Ulcer area (■—■) and ulcer depth (▲—▲) in 58 patients with chronic leg ulcers during the seven-week study period.

ured with a metallic probe, before use desinfected with an antiseptic solution.

Patch tests

In addition to a patch test with Comfeel Ulcus®, a standard patch test (Swedish standard) was performed on patients of Group 2.

Ulcer prophylaxis

When complete healing had occurred, compression stockings were fitted for 27 patients (Group 2) of whom 7 had venous ulcers, 6 arterial ulcers, 12 mixed venous and arterial ulcers and 2 ulcers of different genesis. Because of the high mean age of these patients (75 years, range 37–85 years) the stockings were fitted with a zipper on either the back or the front of the leg, to make them easier to put on and take off. The compression pressure was 30 mmHg (Juzo Helastic-AD 3022, MABS Int., Norrköping, Sweden). These patients were followed up four times during the year after the trial had been completed and frequency of relapses was compared with the frequency in those patients who had not used a fitted stocking.

Statistical methods

Student's *t*-test was used to test differences between means.

RESULTS

According to generally accepted classification of chronic leg ulcers (2) 58 ulcers of 58 patients were distributed as follows. Venous ulcers: 11 (19%), arterial ulcers 13 (22%), mixed venous and arterial ulcers 29 (50%) and ulcers of different genesis 5 (9%). Nine patients, 5 from Group 1 and 4 from Group 2, were excluded from the study. Four patients (Group 1/Group 2—3/1) were admitted to the Department of Surgery (one because of Bowen's disease, two for femorotibial bypass operation, and one for skin transplantation). Three patients (Group 1/Group 2—1/2) whose ulcers were not healed left the study after seven weeks (one died and two were too senile for carrying through the study). Two patients (Group 1/Group 2—1/1) whose ulcers did not heal within the study or the follow-up period were also excluded.

Fifteen (25.9%) of the patients gave a history of deep vein thrombosis of the affected leg and, on clinical examination 16 (27.6%) were found to have varicose veins. Nineteen patients (32.8%) were obese, 7 (12.1%) were hypertensive, 6 (10.3%) were diabetic, 25 (43.1%) had peripheral vascular disease and 31 (53.4%) had non-cardiac oedema.

Wound healing

Twenty-three (39.7%) of the ulcers healed within the seven-week study period (mean 41 days, range 20–49 days) and 49 (84.5%) healed within one year (mean 123 days, range 20–360 days). Fig. 3 shows the changes in ulcer area and depth during the 7 weeks of the study.

Relapse rate

Seven ulcers of 49 (Group 1 and Group 2) recurred within the first year, however, there were no ulcer relapses during the 7 week study period. Compression

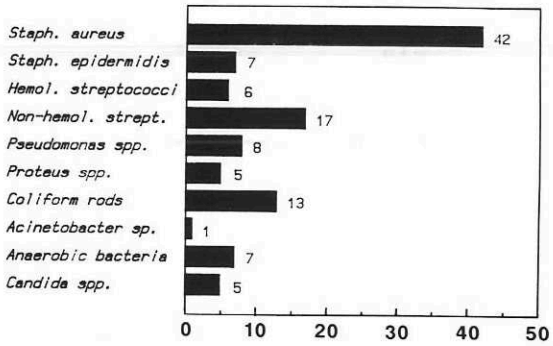

Fig. 4. Bacteriological findings in 58 leg ulcers at the first clinic visit. Number of isolates is outlined.

stockings were fitted for 23 patients (4 patients excluded from Group 2), 17 of these with zippers and 6 without. It was impossible for the latter 6 patients to put on and take off the stockings. Equipment with zippers facilitated the use of compression stockings, but for 2 patients with arterial ulcers compression pressure provoked intolerable pain. Fifteen patients completed this part of the study and no relapses appeared during the observation period, however, there were 6 relapses among the 26 patients (5 patients excluded from Group 1) who did not use the fitted stockings (22.2%).

Microbiology

Fig. 4 shows the results of the cultures for different microorganisms at the patient's first clinic visit. *Pseudomonas aeruginosa* was isolated from the ulcer base in 15 (25.8%) of these, 8 isolates were obtained at the first visit to the clinic and the rest during the study period. The type of leg ulcers from which *Pseudomonas aeruginosa* was isolated at any time during treatment, shown in Table I. Anaerobic bacteria were isolated from the punch biopsy specimens from the ulcers of 7 (12.1%) patients.

Candida albicans was isolated from the wound bases of 14 patients (24.1%). *Candida albicans* was isolated from 5 patients at the first clinic visit and from the remaining 9 during the study period. None of these patients had been treated with antibiotics in the 2 months preceding this study and the types of ulcers are shown in Table II.

Antimicrobial therapy

Only ulcers with clinical signs of infection and from which pyogenic coccia were isolated, were treated with systemic antibiotics in accordance with resistance-testing. Thirty-seven patients (63.8%) received oral antibiotics for 1 week during the study period. Thirty-one patients were treated with erythromycin, 2 with flucloxacillin, 2 with cephalosporine, 1 with clindamycin and 1 with amoxicillin.

Ulcers from which *Pseudomonas aeruginosa* was isolated, were treated with 1% acetic acid jelly occluded with the hydrocolloid dressing. Eleven of the 15 ulcers (73.3%) showed clinical evidence of infection and they responded readily to treatment with 1% acetic acid jelly within 1 or 2 weeks. The clinical signs of infection subsided and cultures became negative. *Pseudomonas aeruginosa* isolated from those 4 ulcers without signs of infection did not respond to treatment with 1% acetic acid jelly. However, presence at pseudomonas aeruginosa did not appear to influence the rate of healing seen in these patients (Fig. 5).

The acetic acid jelly caused transient stinging in two patients which declined spontaneously within 2–3 hours. There were no allergic reactions or other side effects.

Those 7 ulcers from which anaerobic bacteria were isolated were treated for 7 weeks (study period) with

Table I. *The classification of chronic leg ulcers in patients from whose ulcers Pseudomonas aeruginosa was isolated*

Ulcer type	Women	Men	Total	%
Venous	0	1	1	06.7
Arterial	2	1	3	20.0
Mixed	10	1	11	73.3
Other	0	0	0	00.0
Total	12	3	15	100.0

Table II. *The classification of chronic leg ulcers in patients from whose ulcers Candida albicans was isolated*

Ulcer type	Women	Men	Total	%
Venous	2	3	5	35.7
Arterial	1	0	1	07.1
Mixed	6	2	8	57.2
Other	0	0	0	00.0
Total	9	5	14	100.0

Table III. *Serum levels in μmol/l (± SD) of iron, copper, zinc and selenium, compared to age and sex-matched controls*

	Entrance	After 8 weeks	Controls	*p*-value
Iron	10.1 (4.5)	11.3 (4.2)	13.2 (5.2)	NS
Copper	19.2 (2.8)	19.2 (2.5)	18.1 (4.0)	NS
Zinc	11.9 (1.5)	12.6 (2.5)	13.1 (2.8)	NS
Selenium	0.9 (0.2)	0.9 (0.2)	1.0 (0.3)	NS

1% metronidazole jelly occluded with hydrocolloid dressing®.

Four of the 14 isolates of *Candida albicans* were classed as saprophytic and were not treated with 1% econazole nitrate jelly. Eight ulcers with abundant growth of *Candida albicans* responded to treatment with 1% econazole nitrate jelly within a period of 2–3 weeks. Two ulcers were resistant to treatment. Negative culture was considered a positive answer to treatment. Recurrence occurred in four ulcers, but responded to repeat treatment with 1% econazole nitrate jelly occluded with hydrocolloid dressing.

Thirty-seven patients received oral antibiotics during the study period and *Candida albicans* was isolated from 11 ulcers (29.7%). *Candida albicans* was only isolated from 3 (14.2%) of the remaining 21 ulcers ($p<0.05$). There were no allergic reactions or other side effects from 1% econazole nitrate jelly. No significant difference in healing rate was found between ulcers treated with 1% econazole nitrate jelly and those not so treated (Fig. 5).

Histopathology

Histopathologic examination of punch biopsies from the 31 ulcers of Group 1 may be summarized as showing ulcerative skin disease with vascular granulations and a reactive vasculitic component with signs of chronic inflammation. One ulcer showed changes consistent with Bowen's disease.

Biochemistry

Low serum iron levels were found in 20 (74.1%) of the 27 patients (Group 2), with anaemia in 11 (40.7%) and reduced serum albumin levels in 3 (11.1%). No attempt was made to treat the patients' low levels of these variables and no differences were noted in the levels from the start to the end of the study. There were no significant differences in the serum levels of zinc, copper, iron or selenium between patients and age and sex-matched control patients (Table III). Neither were there any differences between poor healers and good healers in serum copper levels, nor in serum copper/zinc ratios.

pH and temperature

The pH of the ulcer bases before and after occlusion with hydrocolloid dressings ranged from 7.00–7.78 (mean 7.46) and no changes were seen in infected ulcers even when treated with jellies whose inherent pH was 3.4. pH of the skin of the affected limb ranged from 5.82–6.78 (mean 6.43).

The uncovered ulcer base had a mean temperature of 24.16°C and covered with the hydrocolloid dressing the mean temperature was 26.32°C. The temperature of the skin adjacent to the ulcer was 23.54°C. There was a mean temperature difference between the occluded ulcer base and the adjacent skin of 2.78°C (range 0.72–5.77°C) and between the uncovered ulcer base and the ulcer base occluded with hydrocolloid dressing of 2.16°C (range 0.93–4.37°C). During healing, there was a tendency for the difference between the temperature of the ulcer base and that of surrounding skin to increase. This was independent of the presence of infection, bacterial or fungal contamination and treatment.

Patch tests

In internal reports as well as in the literature allergic reactions to hydrocolloid dressings have been reported in 6 patients (38). Allergic reactions to Comfeel Ulcus® have been reported in 3 cases of which dioctyladipate was found to be the sensitizing substance in one. Patch tests for Comfeel Ulcus® at each patient's first visit to the clinic were negative. One patient became sensitized to the dressing and this was confirmed by a positive patch test (Fig. 2). This reaction was, however, only assessed by its clinical picture and not by histopathological examination. Patch tests using individual constituents of the dressing material were performed as were 1, 5 and 10% in petrolatum, but all were negative.

A Swedish standard patch test was performed on 27 patients (Group 2) and was positive for at least one substance for 15 patients (55.5%). Positive reactions were found against Benzocaine (8 patients), Amerchol (8 patients), Kathon (7 patients), Wool alcohol (6 patients), Quinoline mix (4 patients), and Perfumes (4 patients). There were fewer positive reactions to other constituents of the panel.

Pain scores are shown in Fig. 6.

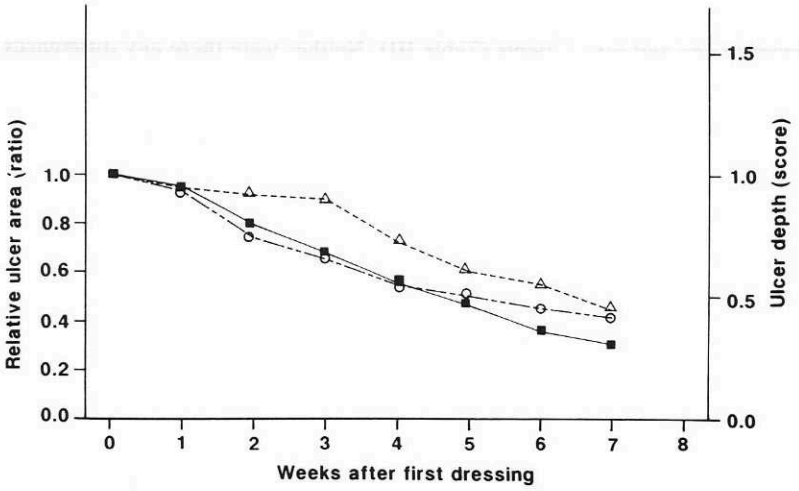

Fig. 5. Ulcer area (■—■) in all 58 chronic leg ulcers and in the 15 ulcers from which *Pseudomonas aeruginosa* (○—○), and in the 14 ulcers from which *Candida albicans* was cultured (△—△) during the seven-week study period.

DISCUSSION

The types of ulcers seen in this study are common. However, there were more mixed venous and arterial ulcers and arterial ulcers in the present material than have been reported in larger series. This may be due to the high mean age of the patients in the study, as a large proportion of arteriosclerotic ulcers would be expected in older patients. There were rather few relapses in this study. A relapse rate of 22.2% was found in patients, who had not used the compression bandage after wound healing. In those who used compression stockings fitted with zippers, no relapses occurred.

Elderly people often suffer from coxarthrosis and gonarthrosis with restricted mobility, consequently the use of ordinary compression stockings with a pressure of 30–40 mmHg was considered impractical and useless. Stockings with zippers facilitated their use and reduced the number of relapses. Practical bandages which are easy to put on and take off may be one method of decreasing the relapse rate of chronic leg ulcers.

In the present study, the distribution of bacteria isolated from the ulcers did not differ from that previously reported from leg ulcer patients.

Ulcers with clinical signs of infection and from which pyogenic coccia were isolated were treated with systemic antibiotics. At the first visit to the clinic, more than half of the ulcers showed clinical signs of infection. Systemic antibiotics were, therefore, pre-

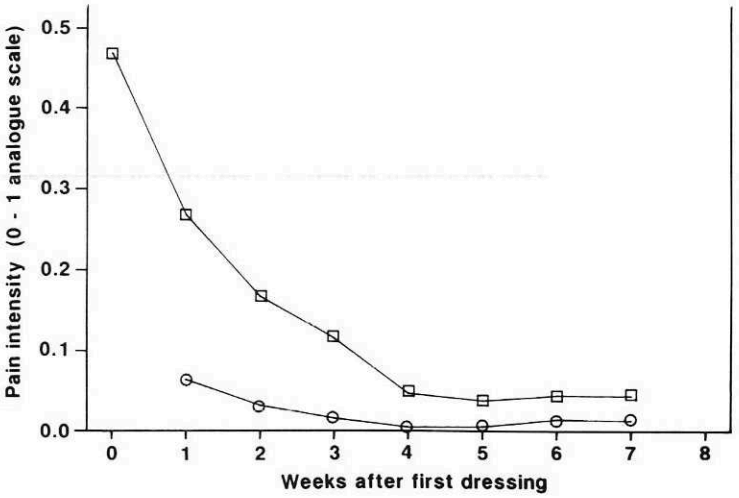

Fig. 6. Mean pain intensity as assessed from linear analogue scales during dressing changes (□—□) and between dressing changes (○—○) in the 58 patients.

scribed to a great number of patients at their second visit, according to resistance-testing. *Pseudomonas aeruginosa,* anaerobic bacteria and *Candida albicans* were treated with 1 % acetic acid jelly, 1 % metronidazole jelly or 1 % econazole nitrate jelly, respectively. The remaining microorganisms were considered to be insignificant to the healing of ulcers occluded with hydrocolloid dressings.

Cultures of *Pseudomonas aeruginosa* are frequently taken from chronic leg ulcers. In the present study, from 25.8 % of the patients. Wound healing may be impaired in chronic leg ulcers infected with *Pseudomonas aeruginosa.* This may not be the case, when *Pseudomonas aeruginosa* is isolated from wounds without signs of infection as colonization of artificial wounds in domestic pigs has been shown to stimulate wound healing (39).

Serum and wound fluid from ulcers treated with occlusive dressings have been shown to reduce the number of bacteria attached to damaged cells. The combination of 1 % acetic acid jelly covered by an occlusive dressing probably has an additive bacteriostatic effect in leg ulcers infected by *Pseudomonas aeruginosa.* 1 % acetic acid jelly was well tolerated by the patients with few side effects. Effective concentrations range from 0.5 % to 5.0 %, but stinging limits the use of concentrations over 1.5 %.

In 12.1 % of the patients, anaerobic bacteria were isolated from the wound base, corresponding well to previously reported studies. However, the significance of anaerobic flora to wound healing in chronic leg ulcers is still unclear. 1 % metronidazole jelly occluded with Comfeel Ulcus® was considered an easy treatment of anaerobic bacteria isolated from the wound base (40). For ethical reasons, repeated culture for anaerobic bacteria was not performed and, therefore, treatment effect on the microorganisms was not assessed. However, the healing rate did not differ from that of ulcers not evidencing anaerobic growth.

Growth of *Candida albicans* has been reported in 20–39 % of leg ulcers, and in the present study 24.1 % of the patients. The isolation of yeast species is not pathognomonic for yeast infection, but together with the clinical picture and the healing rate it may indicate whether significant yeast infection is present. The risk of yeast infection may be increased by the use of topical or systemic antibiotics or steroids, diabetes, or longterm occlusion of the ulcer (41, 42).

Longterm bandaging has recently been reported to cause erythematous lesions with epithelial loss, scaling and pustules around ulcers from which yeast has been isolated. Satellite lesions and large denuded areas have also been described (1). Isolation of yeast species from chronic leg ulcers may thus be a contraindication to continued bandaging. Although only a limited number of patients have been treated in this study, 1 % acetic acid jelly and 1 % econazole nitrate jelly appear to be effective treatments for *Pseudomonas aeruginosa* and *Candida albicans,* respectively. More extensive studies are warranted in order to define the role of these agents in the treatment of chronic leg ulcers infected with these microorganisms. In particular, the significance of anaerobic bacteria for wound healing needs to be investigated.

While two-thirds of the leg ulcer patients for whom measurements were made, were found to have low serum iron levels, and more than one third were anaemic, there seemed to be no correlation between these variables and ulcer healing. However, corrections of these parameters were not performed and, therefore, it is uncertain whether or not normalization would have improved wound healing in these patients (43, 44). Low serum levels of selenium, copper, iron and zinc have been suggested to be associated with reduced healing rates, but no differences in levels of these trace metals were found in patients considered to be good healers as compared with those considered poor healers.

Despite the fact that jellies used in this study had a low pH, no difference in pH values at the ulcer bases could be determined in treated and untreated ulcers. Neither was any effect seen on wound pH by the presence of infection or bacterial or yeast contamination. Alkaline pH and a relatively low temperature compared to body temperature at the wound base impede the supply of oxygen to the tissues. A low oxygen tension is supposed to exist at the ulcer base occluded by hydrocolloid dressings, however, low oxygen tension has also been shown to stimulate wound healing.

Occlusion of the ulcer with the hydrocolloid dressing Comfeel Ulcus® appeared to maintain pH and ulcer base temperature at a level that did not negatively influence healing. All the dressings were well tolerated with only one patient becoming sensitized to Comfeel Ulcus®.

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