

Beethoven Saal

14.00–15.30

## V 13

**Structures and functions of wound care centres in Europe****Strukturen und Funktionen von Wundbehandlungszentren in Europa**

## V 13-2

**Structures and function of wound healing centres in Denmark***F. Gottrup*

**Finn Gottrup, Professor of Surgery, University of Southern Denmark, University Center of Wound Healing, Department of Plastic Surgery, Odense University Hospital, Odense, Denmark**

*Objective:* To improve prophylaxis and treatment of patients with all types of problem wounds. This is achieved during establishment of a multi-professional organisation in the primary as well as in the secondary health care sector.

*Methods:* A multi-professional organisation has been established in the secondary health care sector. It consists of two hospitals units (Copenhagen Wound Healing Center in Copenhagen and The University Center of Wound Healing in Odense) and different types of smaller centre and team functions around in Denmark. Collaboration models for relationship between the hospital and community sectors are presently discussed. The intention is to create the organisation as a national expert area called "Clinical Wound Healing", which also focus on how medical doctor can be educated to national accepted experts in wound healing.

*Results:* Clinically the organisational model has been started and been running for some years. The referral policy has been simplified with only one place to refer to in the hospital. Furthermore patient can be referred from all over the country without any restrictions. Treatment plans including diagnostics, treatment and prevention have been optimised. Beside clinical work different types of educational services, basic and clinical research and prevention programs have been established. Evidences based research is a main task for this organisational model. This is achieved by measuring clinical as well as quality of life outcomes. Evidence for improved quality of care following the formation of specialist wound centres has been shown for different types of wounds. Establishment of a wound database including socio-economical data is important. This type of database, primarily for patients with diabetic foot ulcers, is presently being initiated in University Center of Wound Healing in Odense.

*Conclusion:* The optimal way to deliver wound care in both the hospital- and community sector is still under evaluation. Development of organisational models including databases, systemic evaluation of quality of care and outcome measures may in the future give us the ideal and optimal method of organisation of wound care delivering.

## V 13-6

**Gesundheitsbericht: Chronische Wunden im Ennepe-Ruhr-Kreis***H.-J. Boschek*

**Kreisgesundheitsamtes Ennepe-Ruhr, Schwelm, Germany**

*Einleitung:* Rund 2 % der Bevölkerung leiden an einem Ulcus cruris oder einem Dekubitus bzw. einem diabetischen Fußsyndrom. Die Patienten sind ihrer Lebensqualität durch ihr Leiden erheblich eingeschränkt. Die Kostenträger haben eine finanzielle Belastung in Milliardenhöhe. Wegen der erstrangigen gesundheitspolitischen Bedeutung hat der Ennepe-Ruhr-Kreis das CWEN-Projekt (= chronischen Wunden im EN-Kreis) initiiert. In dem Gesundheitsbericht wird die Situation der Menschen mit chronischen Wunden dargestellt und Handlungsoptionen entwickelt um die Versorgung der betroffenen Patienten zu verbessern.

*Methodik:* Teilprojekt Dekubitus im Pflegeheim: Eine Stichprobe von 619 Risikofällen der 3400 Heimbewohner im Ennepe-Ruhr-Kreis wurde durch speziell geschulte Pflegefachkräfte auf das Vorkommen von Dekubitus, begleitende Risikofaktoren, die Durchführung von Präventionsmassnahmen und der Wundversorgung untersucht. Parallel wurde eine Befragung von Pflegefachkräften und niedergelassenen Ärzten über die Qualität der Kooperation bei der Versorgung von Dekubituspatienten durchgeführt.

*Ergebnisse:* Die Häufigkeit von Dekubitusfällen in Pflegeheimen im Ennepe-Ruhr-Kreis betrug 4 %, davon sind zwei Drittel der Fälle erst im Pflegeheim entstanden. Als patientenbezogenen Risikofaktoren konnten insbesondere Mangelernährung

und das Vorliegen eines Blasenkatheters identifiziert werden. Kein Zusammenhang war zwischen der Personalausstattung (Zahl, Fachkräfteanteil) der Pflegeheime und der Dekubitusprävalenz nachweisbar. Bei der Prophylaxe bestehen Probleme durch den Einsatz von ungeeigneten Lagerungsmitteln. Die Dokumentation der Prophylaxemaßnahmen und Wundversorgung war unzureichend. Im Mittel bestanden die Dekubitusgeschwüre 6 Monate, die dokumentierten Therapieverfahren entsprachen in ca. der Hälfte der Fälle nicht den anerkannten Versorgungsstandards. Die Hälfte der Patienten mit Dekubitus leiden an Schmerzen, die in jedem zweiten Fall nicht therapiert werden. Kooperationsprobleme bestehen bei der Prophylaxe zwischen Pflegeheimen und Pflegekassen (75 %) und bei der Therapie zwischen Pflegekräften und niedergelassenen Ärzten (61 %).

*Diskussion:* Die Prävalenz von Dekubitus ist niedriger als bisher angenommen. Trotzdem bestehen Verbesserungspotentiale bei der Prophylaxe und der Therapie. Schwerpunkte sind das Risiko-Assessment, der rechtzeitige Einsatz geeigneter Lagerungsmaterialien und die Optimierung der patientenbezogenen Risikofaktoren (Unterernährung, Management der Inkontinenz). Besonders bedeutsam ist die Verbesserung der Kooperation zwischen Pflege und den ambulant tätigen Ärzten. z.B. durch die Einführung von Wundbeauftragten in Pflegeheimen. Aus der Sicht der Gesundheitswissenschaften sind bei dem Thema Dekubitus besonders die Aspekte Prävention, die Verbesserung der Lebensqualität der Patienten und Fragen der Optimierung der Kooperation im ambulanten Versorgungssystem bedeutsam.

Freitag, 16.09.2005

Hauptsitzung V 14

ETRS

Schiller Saal

14.00–15.30

## V 14

### *Fibrotic Tissue Responses II*

#### V 14-1

#### *From Bruck's syndrome to fibrosis: New insights into collagen-linking and wound healing*

*R. Bank*

Ph D Dr. Ruud A. Bank, Division biomedical Research, TNO Quality of Life, Zernikedreef 9, 2333 CK Leiden, Email: ra.bank@pg.tno.nl

Fibrotic processes in humans are characterized by an excessive accumulation of collagen containing increased levels of pyridinoline cross-links. The occurrence of these cross-links appears to be an important criterion in assessing the irreversibility of scarring. Collagen containing pyridinoline is less susceptible to proteolytic degradation by matrix metalloproteinases, resulting in an unwanted accumulation. The enzyme responsible for the formation of pyridinoline crosslinks, the recently identified telopeptide lysyl hydroxylase (PLOD2), is an attractive target to attenuate scarring.

#### V 14-2

#### *Collagen turnover in normal dermis versus scars*

*M. Ulrich*

Dr. Magda Ulrich, Association of Dutch Burn Centers, Po Box 1015, 1940 EA Beverwijk, NL, Email: mulrich@burns.nl

The extracellular matrix plays a crucial role in tissue homeostasis and determines the architecture of a tissue. The extracellular matrix is not a static substance in which cells reside, but active remodelling takes place constantly. Under normal physiological conditions a dynamic steady state is maintained, which is necessary for the correct functional properties of the organ.

Fibroblasts are the most important cells in extracellular matrix turnover. The principal constituents of the extracellular matrix in the dermis are the collagens (type type I, III and V). Together with other components (e.g. elastin and proteoglycans) they form a complex network which determines the mechanical resistance and elasticity of the skin. Remodelling of the extracellular matrix is strictly regulated by balanced processes involving synthesis, degradation and cross-linking. In (hypertrophic) scars this balan-

ce is disturbed. Excessive collagen deposition and altered remodelling results in a tissue with different architecture and mechanical and elastic properties. Several processes involved in scar formation will be discussed.

### V14-3

#### ***Regulation and dysregulation of the myofibroblast in tissue repair***

***A. Desmoulière***

Normal wound healing includes a number of overlapping phases. After injury, there is an early inflammatory step characterized by hemorrhage and clotting. In the next phase allowing the development of the granulation tissue, fibroblasts invade the wound and commence replacing the provisional matrix with a more mature wound matrix. As the granulation tissue phase proceeds, fibroblasts start showing a new phenotype with prominent microfilament bundles. These typical myofibroblasts have been shown to express a-smooth muscle actin, and are responsible for wound contraction. Lastly, in the resolution phase of healing, there is considerable loss of various cell types including myofibroblasts, by apoptosis. Inappropriate delay of apoptosis, and thus increased survival of myofibroblasts activated during the healing process, may be a factor which leads to excessive scarring.

### V 14-4

#### ***Assessment and treatment of scarring***

***M. Romanelli***

**M. Romanelli, MD PhD, V. Dini, MD, F. Salibra, MD., Wound Healing Research Unit, Department of Dermatology, University of Pisa, Italy**

Hypertrophic scars and keloids represent two major complications in acute and chronic wound healing. The quality of life of patients with scarring problems could be extensively affected by this aspect and proper assessment together with an effective treatment is mandatory. In the last few years several non invasive objective devices have shown significant data as a potential tools to measure different physical parameters on scarring. Clinical aspects such as colour, tissue density, elasticity, plasticity, hardness, tissue perfusion have been investigated with reproducible and validated results. Little consensus is available about treatment options, mainly because the limited numbers of controlled, comparative studies in this field. Medical and surgical treatment modalities have been used either alone or in various combinations with different outcomes. This presentation will review traditional and advanced treatment options for hypertrophic scars and keloids.

Hegel Saal

14.00–15.30

## V 15

# Bridging the gap: difficult to heal wounds

### V 15-1

#### *Reviewing the Evidence*

*E. A. Nelson*

**E. Andrea Nelson PhD RN, Reader, School of Healthcare, Baines Wing, University of Leeds, P.O. Box 214, Leeds LS2 9UT**

This presentation will summarise the evidence on the effectiveness of interventions for treating difficult to heal wounds, highlighting the limited information available from existing research to guide clinical practice.

Difficult to heal wounds may be loosely defined as those which are failing to heal in a timely manner despite treatment with standard treatments – and an accompanying presentation by Margolis will review methods for identifying these systematically. A review of systematic reviews of the effectiveness of interventions for healing diabetic foot ulcers, pressure ulcers and venous leg ulcers will be presented to illustrate the challenges in extracting information on the characteristics of participants in randomised controlled trials, and the lack of information on severity of wounds and prognosis to allow readers to compare the populations to those in their practice. A small number of randomised controlled trials have specifically addressed the population of difficult to heal wounds and the approaches used by these studies, such as providing detailed baseline data, using wash-out periods, and implementing best practice for accompanying therapies, will be summarised.

### V 15-2

#### *Techniques to Identify Difficult to Heal Wounds*

*D. J. Margolis*

**David J. Margolis MD PhD, University of Pennsylvania School of Medicine, Philadelphia PA USA**

Not all chronic wounds heal in a reasonable period of time. This is even true for wounds that have received standard therapy as well as best therapy. Several studies have been conducted that have yielded information that can be used to delineate at least two clinical wound phenotypes-easy to heal wounds and harder

to heal wounds. The parameters that are used are simple clinical characteristics of the wounds like the size of the wound, the age of the wound, the anatomic depth of the wound, or the rate of change in wound size. The two wounds types that have been the best studied with regard to these characteristics are venous leg ulcers and diabetic neuropathic foot ulcers. Data will be presented that can be useful in clinically differentiating easy from hard to heal wounds at the first patient encounter and four weeks after initiating care. The presentation will include data derived from cohort studies as well as randomized clinical trials. The information presented should be helpful to clinicians and to those planning clinical studies.

### V 15-3

#### *Designing clinical trials by the clinicians in wound healing*

*P. Senet*

**P. Senet, Hopital Charles Foix, Hopital Rothschild, Paris, France**

Randomised controlled trials (RCT) set the methodological standard of excellence in medical research and are essential to move from an experience-based medicine to an evidence-based medicine. In the field of wound healing, the study design should take care of specific aspects. Several problems arise during the elaboration of a study design:

- the choice of the placebo and the definition of the «good wound care»
- the problem of the double-blindness for a study testing a topical agent or a physical device
- the stratification of patients at the randomisation and the difficulty to obtain comparable groups and homogenous patients, particularly for chronic wounds
- the study power
- the duration of both study and follow-up that should include long term evaluation
- the definition of the outcome criteria and its clinical significance
- the choice of an appropriate measure of the outcome criteria
- the actual aim of the members of the International Comittee of Medical Journal Editors for promoting registration of clinical trials.

Hall Köln, Bonn, Hamburg

14.00–15.30

## V 39

## Proteases and Antiproteases Proteasen und Antiproteasen

## V 39-1

### ***Oxidative stress results in selective oxidative damage and activation of macrophages with enhanced nitric oxide and elastase release contributing to the hostile microenvironment of chronic venous leg ulcers***

**A. Sindrilaru, N. Gall, A. Hainzl, K. Welt, R. Hinrichs,  
C. Hinrichs, T. Peters, E. Peschke, J. Weiss, M. Wlaschek,  
C. Sunderkötter, K. Scharffetter-Kochanek**

University of Ulm, Dermatology and Allergy, Ulm, Germany

**Introduction:** Reactive oxygen (ROS) and nitrogen species (RNS) produced by macrophages in the presence of iron released by erythrocytes have been suggested to be responsible for impaired healing in chronic venous leg ulcers. However, there is little in vivo evidence how ROS and RNS induce cellular events resulting in an unfavorable milieu for healing. Here we analyzed the extent and the functional implications of oxidative damage in inflammatory cells infiltrating chronic ulcers.

**Methods and results:** Immunohistochemical analysis of skin biopsies from patients with chronic leg ulcers showed a prevalence of macrophages (CD68+) and low numbers of neutrophils (CD66+). In contrast, in sequential biopsies of acutely induced wounds, neutrophils were present in high numbers at day one and were significantly reduced with the advent of macrophages at day 2, while both cell types had almost disappeared after 5 days. In chronic, but not in acute wounds, we detected a strong immunoreactivity for 8-hydroxy-2-deoxyguanosine and nitrotyrosine in macrophages, indicating oxidative stress-induced DNA and protein damage. We subsequently established an in vitro human and murine model trying to reflect the pro-oxidant in vivo situation. Human peripheral blood mononuclear phagocytes and murine bone marrow macrophages were exposed to H<sub>2</sub>O<sub>2</sub> and iron, which also lead to generation of 8-hydroxy-2-deoxyguanosine and nitrotyrosine. As a consequence of these alterations we observed an increased, iron-dependent production of nitric oxide ( $p < 0.003$ ) and metalloelastase ( $p < 0.05$ ) by macrophages. Corresponding higher expression of metalloelastase and inducible nitric oxide synthase was detected in skin biopsies from chronic leg ulcers when compared with normal skin or acute wounds.

**Conclusions:** We thus describe a new activation system in which both murine and human macrophages employ very similar mechanisms with regard to NO release. This could have a major impact not only for disturbed wound healing but also for NO physiology in general. Our results indicate that in chronic venous leg ulcer, the enhanced release of nitric oxide in conjunction with ROS leads to nitrosative damage. This oxidative stress is associated with enhanced release of metalloelastase by macrophages, most likely leading to degradation of extracellular matrix proteins, thus further amplifying the hostile environment and impaired healing.

## V 39-2

### ***Effects of the matrix metalloproteinase inhibitor GM 6001 on MMP-2 and MMP-9 levels and collagen degradation in organ-cultured skin***

**U. Mirastschijski<sup>1</sup>, W. Schneider<sup>1</sup>, M. S. Ågren<sup>2</sup>**

<sup>1</sup>Department of Plastic, Reconstructive and Hand Surgery, Otto-von-Guericke-University Magdeburg, Magdeburg, Germany,

<sup>2</sup>Department of Surgery K, Bispebjerg Hospital, Copenhagen University Hospital, Copenhagen, Denmark

**Introduction:** Matrix metalloproteinases (MMP) are important for tissue remodeling by degradation of extracellular matrix proteins. Paradoxically, several broad-spectrum MMP-inhibitors appear to up-regulate MMP, at least the gelatinases MMP-2 and MMP-9, on transcriptional and protein levels. In a previous study, we found that rats treated systemically for 7 days with the synthetic hydroxamate broad-spectrum MMP inhibitor GM 6001 showed increased protein levels and activation of MMP-2 in normal skin compared to control-treated rats. We have therefore examined the dose-dependent effect of GM 6001 on gelatinase protein levels and collagen degradation in organ-cultured rat skin.

**Methods:** Rat skin explants (8 mm) were cultured in 1.0 ml DMEM containing 10 % rat serum and treated with 0 (control), 0.1 µM, 1 µM or 10 µM GM 6001 for 7 days. Media were renewed on days 2, 4 and 6. Skin explants were analyzed for MMP-2 and MMP-9 by gelatin zymography day 7. Hydroxyproline levels were measured in conditioned media from cultured skin as an indicator of collagen degradation in the tissue.

**Results:** GM 6001 increased gelatinase levels dose-dependently compared with controls. Maximal levels and activation of both gelatinases were observed at 1  $\mu$ M GM 6001. GM 6001 at 10  $\mu$ M reduced dramatically the amount of active forms of MMP-2 and MMP-9.

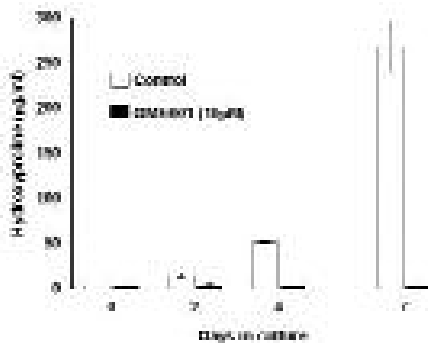


Figure 1: V 39-2 Gelatine zymography.

Hydroxyproline levels increased profoundly in conditioned media of control skin explants with time in culture. Addition of 10  $\mu$ M GM 6001 nullified (100 %) the hydroxyproline release.

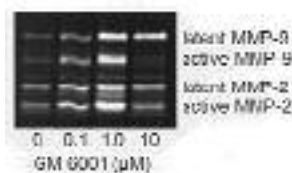


Figure 2: V 39-2

Concentration as low as 0.1  $\mu$ M GM 6001 was almost as effective as 10  $\mu$ M GM 6001 in preventing hydroxyproline release (72 %) from the skin explants.

**Discussion:** This study clearly demonstrates that despite increased levels and activation of MMP-2 and MMP-9 collagen degradation in cultured rat skin was totally blocked with the broad-spectrum MMP inhibitor GM 6001.

### V 39-3

#### **Local treatment with a protease-inhibitor and the effects on cellular expression of matrix-metalloproteases in diabetic foot lesions**

**M. Motzkau, H. Lehnert, R. Lobmann**

University of Magdeburg, Department of Endocrinology, Magdeburg, Germany

**Introduction:** Non-healing ulcerations of diabetic patients are a major health problem. Wound healing in diabetes is impaired and

to understand this at the molecular level is a major focus of research. Persistent high levels of matrix-metalloproteases (MMP's) are relevant factors for wound chronification. The topical use of protease-inhibitors may affect the wound healing and promote the transition from a chronic to an acute wound.

**Methods:** We included 18 patients with chronic diabetic foot lesions (stadium Wagner 2a) in this study. Six patients received standard "good wound care", 12 Patients were additionally treated with a protease-inhibitor (Promogran®, Ethicon) and the dressings were changed daily. At the first visit and after five days a 3 mm punch biopsies were taken from the center of the wound and immediately frozen at -20 °C. All samples were analysed by zymography for MMP-2 pro, MMP-2 active, MMP-9 pro and the dimer form.

**Results:** Levels of MMP-2 and MMP-9 were not different between both groups before treatment. For MMP-2 active a significant reduction in the protease-inhibitor treated group after five days ( $p = 0.012$ ) was found (9004 vs. 17022 pg/ml). The data for MMP-2 pro and MMP-9 (pro and dimer form) were not statistically different between both treatment groups and at the four different time points.

**Conclusions:** The local treatment with a protease-inhibitor beneficially affects clinical wound healing. In previous presented data we demonstrated unchanged mRNA levels of MMP's during treatment with a topical protease-inhibitor. In contrast to this a significant reduction of the biological active MMP-2 in proteases-inhibitor treated wounds was found. In this pilot study similar effects on MMP-2 pro and MMP-9 pro and dimer were not found. Local treatment with proteases-inhibitors does not affect the expression on mRNA but seems to modulate the MMP's in the wound fluid. This could lead to lower active MMP levels on the surface of the wounds with reduced local proteolytic effects and improved wound healing.

### V 39-4

#### **Functional compensation of MMP-13 deficiency by other collagenases in vitro**

**A. Schild<sup>1</sup>, P. Zigrino<sup>1</sup>, B. Hartenstein<sup>2</sup>, P. Ange<sup>2</sup>, C. Mauch<sup>1</sup>**

<sup>1</sup>Department of Dermatology, University of Cologne, Cologne, Germany,  
<sup>2</sup>Department of Signal Transduction and Growth Control, DKFZ, Heidelberg, Germany

**Introduction:** Remodeling of the extracellular matrix during pathological and physiological processes is required in order to allow cell migration, release of factors/bioactive peptides and constant renewal of the extracellular environment. Matrix metalloproteinases (MMP) have been shown to play a decisive role in ECM remodelling during wound healing of the skin. During granulation tissue formation expression and activity of the interstitial collagenases MMP-13 and MMP-14 is increased in response to cytokines and growth factors, as well as in response to extracellular matrices and cell-cell communication. Previously, we have shown that fibroblasts contacting fibrillar type I collagen exhibit de novo synthesis of MMP-13 and MMP-14, which are believed to represent the major interstitial collagenases in mice.

**Methods:** To clarify the specific role of individual MMPs in

the cellular response to ECM components MMP-13 deficient murine fibroblasts were cultured as monolayers and in three-dimensional collagen type I for 48 hours, and compared to fibroblasts derived from MMP-13 flox/flox animals used as controls. Expression and activity of MMPs have been analyzed by RT-PCR (normalized to S 26) and by in vitro gelatin zymography.

**Results:** Contraction of the collagen lattices, which was monitored over 48 hours, showed no differences in the deficient cells as compared to the flox/flox cells. Cultivating of fibroblasts in collagen lattices induced the expression and activation of proMMP-13 and proMMP-14 and as a result of MMP-14 induction, proMMP-2 is activated. Surprisingly, analysis of cell supernatants showed a decreased activation of proMMP-2 in MMP-13 deficient as compared to control cells even though, transcripts levels for MT1-MMP were unaltered in both cells and culture conditions. Interestingly, analysis of the recently described murine MColA and MColB, representing the murine orthologue of human MMP-1, showed upregulation of transcripts in MMP-13 deficient fibroblasts grown as monolayers or in collagen gels.

**Conclusions:** In conclusion, our data indicate that the function of MMP-13 in dermal fibroblasts is not compensated by MMP-14, but rather suggest a role for the two collagenases, MColA and MColB, in compensatory mechanisms activated upon MMP-13 ablation.

(iii) in the actual sutured area and analyzed for collagen concentration, endogenous collagenolytic activity, susceptibility to degradation by exogenous MMP-8 and MMP-9, number of histiocytes (CD68 +) and immunoreactivity of MMP-8 and MMP-9, which are two histiocyte MMPs.

**Results:** The collagen concentration of all biopsies decreased postoperative day 3 in all areas, and even more so in the sutured areas (29 % lower than adjacent non-sutured anastomotic tissue). The initial collagen concentration of the anastomosis was re-established at day 7. Endogenous collagenolytic activity increased dramatically at days 3 and 7 in the sutured areas, but was unchanged in adjacent non-injured colon. This activity was abolished by metalloproteinase inhibitors. Increased collagenolytic activities were associated with increased invasion of histiocytes in the anastomotic wound and sutured areas. All histiocytes were MMP-8 positive and some of them MMP-9 positive in the sutured areas. Interestingly, incubating normal colon tissue with MMP-8 and MMP-9 led to a 3-fold increase in collagenolysis compared to incubations with MMP-8 or MMP-9 alone.

**Discussion:** Our observations show that fragilization of the large bowel wall in the vicinity of an anastomosis 3 days after surgery is associated with a 63 % collagen loss, increased collagenolytic activity, and accumulation of histiocytes rich in MMP-8 and MMP-9, two MMPs that synergistically degrade collagen in suture-holding tissue of an anastomosis.

## V 39-5

### **Characterization of the role of matrix metalloproteinases in colon anastomosis dehiscence**

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<sup>5</sup>Department of Pharmacology, The Danish University of Pharmaceutical Sciences, Copenhagen, Denmark

**Introduction:** A severe complication in colorectal surgery is anastomotic dehiscence occurring in up to 15 % of operated patients 3–4 days postoperatively. The breaking strength is also minimal on postoperative day 3 in a rat model. Treating rats with a matrix metalloproteinase (MMP) inhibitor prevents fragilization of the large bowel wall holding the sutures (Ågren et al. *Mini Rev Med Chem* 2004; 4: 769–78), but neither the identity of the MMP, nor its mode of action is known. We have investigated the contribution of MMPs to anastomotic dehiscence in a standardized animal model.

**Methods:** Left-sided colon anastomoses were made on male rats. At days 0, 3, and 7 after surgery, small biopsies were taken from (i) non-injured colon distal and proximal to the anastomosis, (ii) within the anastomosis area but away from the sutures, and

## V 39-6

### **PACE4 expression and function in latent TGFβ, activation in the megakaryocytic lineage and early wound repair**

### **PACE4-Expression und Funktion bei der Aktivierung latenten TGFβ,s in der Megakaryozytischen Lineage und in Frühstadien der Wundheilung**

R. Blakytyn, G. Brunner

Fachklinik Hornheide, Dept. of Cancer Research, Munster, Germany

**Introduction:** Release and activation of latent transforming growth factorβ (TGFβ) by platelets is one of the earliest responses to wounding. We have previously demonstrated the involvement of a pro-protein convertase-like enzyme in this process, potentially representing the furin family member, PACE4. While furin protein is expressed in megakaryocytic cell lines, PACE4 expression has only been demonstrated at the mRNA level. The furin-like activity that we described earlier in platelets and their releasates has not been fully characterised. We describe here PACE4 mRNA and protein expression in three megakaryocytic cell lines, MEG01, K562 and CHR288, as well as in platelets. In addition, we have analysed the role of PACE4 in latent TGFβ activation by these cells.

**Methods:** RT-PCR was carried out with total RNA using intron-spanning primers for furin and PACE4. Expression of furin-like

enzyme activity in cell lysates was measured using the fluorogenic substrates, pyr-RTKR-AMC (cleaved by furin and PACE4) and boc-QRR-AMC (PACE4-specific). TGF $\beta$  activity was determined in the Plasminogen Activator Inhibitor-1/Luciferase (PAI/L) assay.

**Results:** Megakaryocytic cell lines expressed furin and PACE4 mRNA as well as furin-like activity. Similar to activated platelets, enzyme activity was released into the medium. Lysates of megakaryocytic cells and platelets and platelet releasates cleaved both substrates, pyr-RTKR-AMC and boc-QRR-AMC, indicating that the furin-like enzyme expressed in these cells was PACE4. This was confirmed by inhibitor studies, which revealed that the general furin family inhibitors, dec-RVKR-cmk and hexaarginine, blocked activity with both substrates, whereas the furin-specific inhi-

bitors,  $\alpha$ 1-antitrypsin variant  $\alpha$ 1-PDX and EGTA, did not have significant effects. Similar to activated platelets, megakaryocytes activated latent TGF $\beta$ , and activation was partially inhibited by hexaarginine.

**Conclusions:** We have confirmed the presence of furin and PACE4 mRNA in human megakaryocytic cell lines, and we have identified, for the first time, based on substrate specificity and inhibitor profile, the presence of PACE4 activity in this cell lineage (megakaryocytes and platelets). We have shown that PACE4 is involved in latent TGF $\beta$  activation in the megakaryocytic lineage and, therefore, represents a potential therapeutic target to modulate TGF $\beta$  activity in early wound repair as well as in other pathological states involving platelet activation.

## V 40

# Die besondere Auslese – Preisträgersitzung

### V 40-1

## Körperbild und soziale Unterstützung bei Patienten mit Ulcus Cruris Venosum

A. Uschok

Uni Witten/Herdecke, Heuweiler, Germany

**Fragestellung:** In Deutschland leben rund 1,2 Millionen Menschen mit Ulcus cruris venosum, bekannt als Unterschenkelgeschwür oder „offenes Bein“. Die Lebensqualität dieser Patienten ist deutlich eingeschränkt. Wichtige Problemfelder sind neben Schmerzen und Mobilitätseinschränkungen soziale Isolation, Störungen des Selbstwertgefühls und des Körperbildes [3]. In der vorliegenden Arbeit wird der Frage nachgegangen, ob das Körperbild dieser Patienten durch soziale Unterstützung positiv beeinflusst werden kann. Ziel ist es, Handlungsoptionen zur Verbesserung des Körperbildes zu erschließen.

**Material und Methode:** In der Studie wurden 135 Ulcus cruris venosum - Patienten einer schriftlichen Befragung mit zwei bereits validierten Erhebungsinstrumenten unterzogen. Es handelt sich um den Fragebogen zum Körperbild (FKB-20) von Cle-

ment/Löwe (1996) und den Fragebogen zur sozialen Unterstützung (F-sozU-K-14) von Fydrich/Sommer/Brähler [2].

**Ergebnisse:** Es wurde ein deutlich negatives Körperbild bei den Ulcus cruris venosum-Patienten festgestellt. In der multivariaten Berechnung bestätigte sich ein statistisch signifikanter Zusammenhang zwischen einem zunehmend positiven Körperbild und zunehmender sozialer Unterstützung.

**Schlussfolgerungen:** Der nachgewiesene positive Einfluss sozialer Unterstützung auf die Verbesserung des Körperbildes eröffnet eine weitere Handlungsoption und sollte (z. B. durch die Vermittlung von Selbsthilfegruppen, Nachbarschaftshilfe) in der Versorgung von Ulcus cruris venosum-Patienten verstärkt miteinbezogen werden. Qualitativ hochwertige Wundversorgung ist ohne die Berücksichtigung psychosozialer Faktoren nicht möglich [4].

### Literatur

1. **Clement, U., Löwe, B. (1996):** Fragebogen zum Körperbild. Göttingen: Hogrefe;
2. **Brähler, E. et al (2002):** Diagnostische Verfahren in der Psychotherapie. Göttingen: Hogrefe;
3. **Ebbeskog, B.; Ekman, S.-L. (2001):** Elderly persons' experiences of living with venous leg ulcer. Scand. J. Car. Sci., 15, 3, 2001, 235–243.
4. **Panfil, E.-M.:** Wundpflege ist mehr als Wundmanagement. Pflege aktuell, 58, 4, 2004, 214–217.

## V 40-2

### Inter- and intra-observer agreement among doctors and nurses in the classification of open wounds

#### Können Ärzte und Pflegepersonal Wunden zuverlässig beurteilen?

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**Aim:** In patients with open wounds, clinicians and nurses classify these wounds to assess treatment options, in particular the choice of dressings. Incorrect or discordant classification may lead to suboptimal wound care. We studied the amount of agreement among clinicians and nurses according to the Red-Yellow-Black (RYB)-scheme and regarding their choice of wound dressings.

**Methods:** Digital pictures were taken from a random sample of surgical patients with open wounds. An international expert panel with extensive experience in wound care selected and classified 18 representative pictures. These were subsequently presented to clinicians and nurses of the Department of Surgery, who classified these on the basis of the wound colour, amount of exudation, and choice of dressing material. Group kappa's ( $\kappa$ ) were calculated to assess inter- and intra-observer agreement within the groups of nurses and clinicians, as well as their agreement with the expert panel.

**Results:** A total of 79 clinicians judged the pictures. Their agreement for colour ( $\kappa = 0.61$ ; 95 % Confidence Interval (CI) 0.49 to 0.73) and exudation ( $\kappa = 0.48$ ; 95 % CI: 0.36 to 0.61) was good to moderate. The agreement among 63 nurses was similar. Age and experience of the clinicians showed a positive correlation with classification of wounds according to the RYB-scheme. Agreement on the choice of dressing materials was very poor. Best agreement was found among nurses for their choice of classical dressings ( $\kappa = 0.23$ ; 95 % CI 0.15 to 0.31).

**Conclusions:** The RYB-scheme is a reliable classification scheme for the assessment of open (surgical) wounds and can be used as guidance in the choice of local wound care materials. The choice for wound care materials leaves room for improvement and training.

**Ziel:** Die Klassifikation der Wunden durch Ärzte und Pflegepersonal bei Patienten mit offenen Wunden um somit die Wahl des Verbandsmaterials zu bewerten. Inkorrekte oder Klassifizierung verschiedener Meinung kann zu einer suboptimalen Wundversorgung führen. In unserer Klinik wurde die Kongruenz bei Ärzten und Pflegepersonal gemäß dem Rot-Gelb-Schwarz (RGS) Schema erforscht und somit ihre Wahl für das Verbandsmaterial.

**Methodik:** Von einer Gruppe chirurgischen Patienten mit offenen Wunden wurden digitale Bilder erzielt. Ein internationales Expertenforum mit ausführlicher Erfahrung der Wundpflege wählte und klassifizierte 18 repräsentative Bilder. Diese wurden aufeinander folgend den Ärzten und das Pflegepersonal der chirurgischen Pflegestation dargeboten, welchen die Bilder klassifizierten auf Grund der Verfärbung der Wunde, die Menge der Sekretion und die Wahl des Verbandsmaterials. Die Kappa-Zahl

der Gruppe ( $\kappa$ ) wurde berechnet zur Bewertung der inter- und intra-observer Kongruenz bei den Ärzten und das Pflegepersonal, sowie zur Bewertung der Kongruenz mit dem internationalen Expertenforum.

**Ergebnisse:** Insgesamt 79 Ärzte beurteilten die Bilder. Ihre Kongruenz für die Verfärbung der Wunde ( $\kappa = 0.61$ ; 95% Zuverlässigkeitsintervall (ZI) 0.49 bis 0.73) und für die Menge der Sekretion ( $\kappa = 0.48$ ; 95% ZI: 0.36 bis 0.61) war gut bis moderat. Die Kongruenz für die 63 Personen des Pflegepersonals war gleichartig. Das Alter und die Erfahrung der Ärzte korrelierten positiv mit der Bewertung oder Klassifizierung der Wunden gemäß dem RGS-Schema. Die Kongruenz für die Wahl des Verbandsmaterials war sehr schwach ( $\bar{\kappa}$  0.07 bis 0.23). Das Pflegepersonal zeigte die beste Kongruenz in der Wahl für das klassische Verbandsmaterial ( $\kappa = 0.23$ ; 95 % ZI 0.15 bis 0.31).

**Schlussfolgerungen:** Die Wahl der Verbandsmaterialien lässt Raum für Verbesserung und Weiterbildung bei Ärzte und Pflegepersonal. Das Rot-Gelb-Schwarz-Schema bewährt sich zur Beurteilung von offenen chirurgischen Wunden und ist ein gutes Leit-system zur Verbesserung der Wahl der Verbandsmaterialien.

## V 40-3

### Modulation der Wachstumsfaktorenexpression in Wundgewebe durch Vakuumtherapie nach Vorbestrahlung?

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**Einleitung:** Nach Strahlentherapie können kurz- aber auch langfristig konsekutive mikro- und makroskopische Veränderungen des Gewebes auftreten. Als Folge dieser Veränderungen kann es zu schweren Wundheilungsstörungen kommen, die sich gegenüber konventionellen Behandlungsmethoden als therapieresistent erweisen. Eine rasche deutliche Verbesserung der Wundgesamtsituation ist unter Vakuumtherapie zu sehen, ohne dass jedoch der Wirkmechanismus geklärt ist.

**Methodik:** Im Rahmen des allgemeinen Wunddebridements im Bereich eines Radioderms wurde mit Einverständnis der Patienten aus dem Wundrand und dem Wundgrund vor der Vakuumtherapie sowie 4 Tage nach kontinuierlicher 125 mmHg Sogwendung (V.A.C., KCI) Biopsien entnommen. Die zuvor durch HE-Färbung als Granulationsgewebe identifizierten paraffinfixierten Schnitte wurden mittels CD31, VEGF (Vascular Endothelial Growth Factor) und HIF-1 $\alpha$  (Hypoxia inducible factor-1 $\alpha$ ) angefärbt. Die spezifische Anfärbung von proliferierenden Endothelzellen erfolgte hingegen mit dem Antikörper CD 10<sup>5</sup>. Aus fünf zufällig ausgewählten Areale von 1,0  $\times$  10<sup>2</sup> 4 mm<sup>2</sup> erfolgte die verblindete semiquantitative Auswertung der Schnitte durch lichtmikroskopische Auszählung bei 200 facher Vergrößerung. Ermittelt wurde die Anzahl der angefärbten endothelausgekleideten Lumina (CD31), VEGF-Expression und die HIF-1 $\alpha$  gefärbten Zellker-

ne. Zur Quantifizierung der gewonnenen Ergebnisse wurde eine RT-PCR heran gezogen.

**Ergebnis:** Klinisch zeigte sich eine deutliche Verbesserung der Wundgesamtsituation unter Vakuumtherapie. Die immunhistologischen Untersuchungen zeigte, dass es unter Vakuumtherapie zu keiner relevanten Progression der Anzahl an Kapillaren in der präoperativ bestrahlten Wunden kommt. Vielmehr zeigte sich eine Reduktion der Kapillargesamtzahl bei gleichzeitig vermehrter Gefäßfüllung und Reife. Eine deutliche Veränderung unter Vakuumtherapie zeigte dagegen die Expression von HIF-1 $\alpha$  auf.

**Schlussfolgerung:** Die semiquantitative Analyse der immunhistochemischen Untersuchungen zeigt, dass es zwar nicht zu einem signifikanten Anstieg der Anzahl an neu gebildeten Kapillaren nach Vakuumtherapie zu kommen scheint, was man typischerweise als Anzeichen einer Induktion von Neovaskularisation in chronischen areaktiven Radiodermen erwarten würde. Jedoch weist der signifikante Abfall angefärbter Zellkerne auf eine Verbesserung der Gewebeoxygenierung auch in schwer strahlengeschädigten Gewebe hin. Dies ist für den klinischen Einsatz der Technik bei der Geweberekonstruktion und auch für Tissue Engineering Ansätze von Relevanz. Dieses Bild wird unterstützt durch die in anderen Studien bereits nachgewiesene Steigerung der Mikrozirkulation unter Vakuumtherapie. Der genaue biologische Funktionsmechanismus der Vakuumtherapie und der Gewebeveränderungen unter Strahlentherapie bedarf weiterer Aufklärung.

## V 40-4

### **VAC therapy and the diabetic foot syndrome – clinical outcome in 122 patients**

#### **Vakuum-Therapie beim diabetischen Fußsyndrom: Verlaufsbeobachtung bei 122 Patienten**

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**Introduction:** The diabetic foot syndrome presents a particular challenge in wound healing. The aetiology of these wounds is complex and often leads to amputation. A combination of neuropathy with subsequent loss of protective sensation and compromised circulation play a key role in this process. Frequently this consists with a complicated infection involving deep tissue and bone. VAC therapy is a new approach in optimising wound therapy.

**Methods:** From July 2003 till March 2005 122 in- and outpatients (126 wounds) with diabetic foot syndrome were treated with local negative pressure therapy. A therapy cycle with the VAC usually lasted 3–5 days, followed by 1–2 days interval to allow regeneration of the surrounding tissue. At the beginning of treatment a polyurethane foam was applied with continuous suction of 125 mmHg later changed to PVC foam with 175 mmHg of suction when the wound became more superficial. Our aim utilising this method was to accelerate and improve the condition of granula-

tion tissue, an apparent control of infection and a reduction of oedema. Complications during treatment were documented.

**Results:** 78 of the 122 patients (64 %) presented with significant compromised circulation and 102 cases (84 %) with concurrent PNP. The total treatment time was 2942 days resulting in a mean value of 23 days per patient (median 17.5 days). A positive outcome was achieved in 102 out of 126 wounds (81 %). In the patient subgroup who received an interventional PTA or bypass surgery an improved outcome was observed. In 8 patients therapy was halted due to poor compliance and other non-treatment-related reasons. In 2 cases (2 %) hypersensitive reaction against the adherent film caused treatment failure. Therefore treatment had to be stopped in a total of 10 patients (8 %). No serious adverse events were observed during outpatient treatment.

**Conclusions:** Local negative pressure application (VAC therapy) offers an effective management of the diabetic foot syndrome with improvement to the local wound condition and increased development of granulation tissue. This success rate of 81 % in our cohort has been well documented by other professionals in various publications. This method is simple to apply and no significant complications were observed.

**Hintergrund:** Das diabetische Fußulkus stellt eine besondere Herausforderung in der Wundbehandlung dar. Die Ätiologie der Wunden ist komplex, wobei die diabetische Polyneuropathie mit Verlust des schützenden Schmerzempfindens sowie Durchblutungsstörungen (pAVK) eine Schlüsselrolle einnehmen. Häufig bestehen komplizierende Infektionen mit Gewebsdefekten, die eine Knochenbeteiligung einschließen. Therapeutisch steht im Bereich des Wundmanagements mit der Vakuumtherapie (VAC<sup>®</sup>-Therapie KCI<sup>®</sup>) eine neue Methode zur Verfügung, die eine Konditionierung des Granulationsgewebes, Sekret Drainage, Infektionskontrolle und Ödemreduktion optimiert.

**Material und Methode:** Im Zeitraum von Juli 2003 bis März 2005 wurden 122 Patienten (126 Wunden) mit einem diabetischen Fußsyndrom sowohl stationär als auch ambulant mittels Vakuumtherapie behandelt. Ein Therapiezyklus mit der VAC<sup>®</sup> betrug in der Regel 3–5 Tage, gefolgt von 1–2 Tagen therapiefreiem Intervall zur Regeneration des Umgebungsgewebes. Primär kam ein Polyurethanschaum mit kontinuierlichem Sog von 125 mmHg zum Einsatz, bei flächiger Granulation wurde auf den Polyvinylschwamm mit 175 mmHg Sog gewechselt. Als Therapieziele wurden ein beschleunigter Aufbau von Granulationsgewebe, eine makroskopisch sichtbare Infektkontrolle und eine Ödemrückbildung definiert. Zur Beurteilung der Anwendungssicherheit wurden Komplikationen im Therapieintervall erfaßt. Das Erreichen der Therapieziele wurde als positiver Behandlungserfolg gewertet.

**Ergebnisse:** Bei 78 der 122 Patienten (64 %) bestand eine signifikante pAVK, in 102 Fällen (84 %) lag eine Polyneuropathie vor. Insgesamt wurden 2942 Anwendungstage gezählt. Die mittlere Anwendungszeit pro Patient betrug 23 Tage (median 17,5 Tage). Insgesamt konnte bei 102 der 126 Wunden (81 %) ein positiver Behandlungserfolg beobachtet werden. Die Untergruppe der Patienten, die mittels interventioneller PTA oder Bypasschirurgie revaskularisiert wurden, zeigte tendenziell ein besseres Auskommen. Bei 8 Patienten (7 %) musste die Therapie wegen mangelnder Compliance bzw. aufgrund einer notwendigen Verlegung zur Behandlung von Komorbiditäten vorzeitig beendet werden. In zwei Fällen (2 %) entwickelte sich eine lokale hypersensitive Reaktion auf die zur Abdichtung verwendete Wundfolie, so dass bei insgesamt 10 Patienten (8 %) Komplikationen einen

vorzeitigen Therapieabbruch bedingt haben. In der ambulanten Therapie wurden keine gravierenden Komplikationen beobachtet.

**Zusammenfassung:** Die Vakuumpumpentherapie mit dem VAC®-System ist auch beim diabetischen Fußsyndrom eine effektive therapeutische Alternative zur Verbesserung der lokalen Wundverhältnisse und Förderung des Gewebeaufbaues. Der hohe Anteil von positiven Behandlungserfolgen (81 %) in unserem Kollektiv deckt sich mit den Publikationen anderer Autoren. Die Methode ist komplikationsarm und einfach in der Anwendung.

## V 40-5

### **Treatment of chronic bacterial infections with a polyvalent bacteriophage solution**

#### **Bakteriophagotherapie der chronischen Infektionen mit der polyvalenten Phagenlösung**

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**Introduction:** Bacterial infection is a common problem among hospitalized patients. The sometimes uncritical application of antibiotics has led to increasing problems with multiresistant bacteria. The risk of having a pathogen bacterial species that is not sensible to any agent is threateningly. Infected as well as contaminated patients have to be isolated during their time of hospitalisation making their handling much more complicated. In former socialist east europe countries bacteriophages were successfully applied in the treatment of bacterial infections. This pilot study investigates the effectiveness of the polyphages solution DePhag® for the treatment of chronic musculoskeletal infections.

**Material and Methods:** After permission by the institutional review board ("Ethikkommission") eight patients having nine chronic musculoskeletal infections were treated with DePhag® in a non-randomised prospective study. Treatment was as following. After surgical debridement with reomoval of all necrotic tissue DePhag® was applied by irrigation and finally by drenched dressings. The application of DePhag® was repeated daily during wound visitation. Swabs were taken on each third day. Eradication of the bacterium was defined with three following negative swabs.

**Results:** Seven of nine cases gained elimination of the agent. The interval between the day of operation and the first of three consecutive negative swabs was six days on median (range 5 to

**Discussion:** This is the first report in the literature about bacteriophage-therapie for the treatment of chronic bacterial infections with special emphasis on multiresistant agents. The polyphages solution DePhag® had been shown to be effective in the elimination of chronic bacterial bone and soft-tissue infection after failed combination of antibiotic and surgical treatment. Because bacteriophages do not aim on human cells no side

effects should be expected. The recorded shivering fit may be addressed to endotoxin Ausschüttung after the decay of the agent. Furthermore this study has proven the effectiveness on the agents of one local institution. These findings suggested the effectiveness of DePhag® on a wide bacterial spectrum, especially on MRSA.

Chirurgische Wunden mit MRSA Erregern stellen ein zunehmendes Problem in der klinischen Praxis dar. Als Alternative zur Antibiotikatherapie kommt die Therapie mit Bakteriophagen in Betracht. Bakteriophagen sind T 4 Viren, welche sich ausschließlich gegen Bakterien wenden. Wir möchten über unsere ersten klinischen Erfahrungen bei der Behandlung von Weichteil- und Knocheninfekten in einem unfallchirurgischen Krankengut durch die Anwendung von Bakteriophagen berichten. Hier wurden unter Beaufsichtigung der Ethikkommission 9 Patienten mit Bakteriophagen therapiert. In der Regel handelte es sich hier um infizierte Wunden nach Behandlung von Weichteil- und offenen Frakturen. Diese Patienten hatten in der Regel eine offene Wundbehandlung erhalten, welche für den örtliche Einsatz von Bakteriophagen geeignet war. Die Standardtherapie bestand aus Debridement und feuchten Verbänden mit Staphylophagenlösung. Im Vordergrund stand hier die örtliche Infektsanierung, welche nach einer Wundreinigung einen sekundären Wundverschluß, eine Spalthautverpflanzung oder eine Lappendeckung möglich machte. 9 Patienten, die mit einer einwöchiger Phagenbehandlung therapiert wurden, ergaben mikrobiologische verlaufskontrollen keinen Keimnachweis. Bei 2 multimorbiden Patienten konnte ein Teilerfolg (definiert als vorübergehende Keimfreiheit) erzielt werden. Die erste Ergebnisse zeigen eine hohe Wirksamkeit von Phagen auf MRSA resistente Keime *in vitro*, sowie *in vivo*. Das Präparat ruft keine allergische Reaktionen, sowie Nebenwirkungen hervor und hat bisher keine Gegenanzeigen und Risiken. Wir folgern aus diesen Ergebnissen, dass auch bei dem hiesigen multiresistenten Erregerspektrum Bakteriophagen erfolgreich eingesetzt werden können, als Alternative zur Antibiotikatherapie

## V 40-6

### **Dekubitusreduktion; Vom Papier ans Patientenbett ein Qualitätsprojekt**

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Dekubitus stellt ungeachtet der medizinisch-technischen Entwicklung weiterhin ein aktuelles Problem in der Pflegepraxis dar. In Genf haben Perneger et al. (1998) in einer gross angelegten Prävalenzuntersuchung festgestellt, dass jeder 10. Patient einen Dekubitus während seinem Aufenthalt im Krankenhaus entwickelt. Dies entspricht dem internationalen Vergleich [Clark, 2002]. Evidenzbasiertes Leitlinien sind vorhanden und doch scheint die Umsetzung am Bett oftmals schwierig. Im Rahmen der Qualitätssicherung und -förderung wurden 2002 mit wenig Aufwand anhand einer Dokumentenanalyse erste Zahlen von vorhandenen Dekubitalulzera (Stadium I-IV) für das gesamte Haus, ermittelt (12 %). In einem weiteren Schritt wurde die Qua-

lität der vorhandenen Lagerungsmaterialien überprüft und Strukturen geschaffen, die es den Pflegenden ermöglichen evidenzbasierte Entscheidungen für die Dekubitusprävention und Therapie zu treffen. Alle Pflgeteams wurden mit den neusten Forschungserkenntnissen betreffend wirksamer Prophylaxe konfrontiert und geschult. Erste Erfolge waren bald sichtbar. Ein Jahr später wurde die Erhebung wiederholt, um die eingeleiteten Maßnahmen zur Dekubitusreduktion zu überprüfen. An verschiedenen Stichtagen wurden im Herbst stationsweise alle Patientinnen und Patienten (276) welche für eine Teilnahme

einwilligten von der Pflegeexpertin und einer Stationsleitung auf das Vorhandensein eines Dekubitus systematisch untersucht. Gegenüber dem vorigen Jahr konnte mit den eingeleiteten Maßnahmen die Anzahl der Dekubitalulzera (Stadium I–IV) um 45 % reduziert werden. Im Rahmen des PDCA-(Plan, Do, Check, Act) Qualitätskreislaufs wird am Kantonsspital weiter an der Reduktion von Dekubitalulzera gearbeitet. Das Verhindern von Komplikationen ist und bleibt für die Pflegenden eine Kernaufgabe.

## V 41

### *Ulceration of the lower limb I*

#### V 41-1

#### ***Factors influencing venous leg ulcer recurrence: Implications for practice***

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*Aim:* To investigate what factors influenced the level of ulcer recurrence.

*Methods:* A retrospective study of a cohort of patients initially treated between June 1998 and July 2000 were identified. A postal questionnaire was sent to 114 patients with 135 previously ulcerated limbs (67 % of these were recurrent ulcers at initial presentation to the leg ulcer clinic). Supporting data was obtained from leg ulcer clinic records and this was used to augment and validate the questionnaire data. All patients were issued with ulcer recurrence prevention advice and were provided with European Class II support hosiery on healing of their initial reference ulcer. Follow up after healing was in the Community. All but one patient returned to the leg ulcer clinic for treatment when recurrence occurred.

*Results:* The response rate was 68.4 % (78 patients). There were 116 recurrent ulcers in 44 patients in the survey period. 59% of the recurrent ulcers occurred within the first year after reference ulcer healing, 39 ulcers recurred within 200 days of healing, the bulk of these occurring in the first 90 days. All recurrent ulcers healed within a similar timeframe however those patients who's initial ulcer was a primary ulcers tended to heal more rapidly than those with recurrent ulcers. Ulcer recurrence rates were related to both patient and ankle mobility (with statistically significant differences between groups), initial ulcer size and gender it was however impossible to relate recurrence rates to reported hosiery use. Many patients lacked sufficient support to use hosiery effectively and ongoing community follow up, including Doppler ABPI, was poor.

*Conclusions:* Clinical experience and data from this study supports the literature and serves to emphasise the problem of venous ulcer recurrence. Patients would appear to be at the greatest risk of recurrence within the first three months after healing. Patients with poor mobility and large ulcers (> 10cm<sup>2</sup>) are at greatest risk. Preventative strategies need to target these groups and to concentrate resources in the initial period after healing if maximum benefit is to be achieved. If hosiery is to be used effectively in these patients greater support will be needed.

## V 41-2

**Factors that influence the frequency of rebandaging**U. Adderley<sup>1</sup>, C. Thompson<sup>2</sup><sup>1</sup>Scarborough, Whitby and Ryedale Primary Care Trust, Malton, North Yorkshire, United Kingdom,<sup>2</sup>University of York, York, United Kingdom

*Introduction:* Caring for patients with venous leg ulceration care is costly in terms of both dressing materials and nursing time. Although weekly reapplication of multilayer compression bandaging is generally recommended, there is evidence that patients are often seen more frequently. The reasons for this are unclear [2].

*Methods:* This paper will report the results of a qualitative study which used observations and exploratory interviews with three District Nursing teams working in the north east of England to identify the factors that impact on decision making with regard to the timing of the reapplication of compression bandaging. Thematic analysis was used to identify factors which were then considered within four categories based upon DiCenso, Cullum and Ciliska's (1998) model for evidence-based decisions.

*Results:* The study identified four main categories;

- factors relating to clinical expertise
- factors relating to resources
- factors relating to patient preferences, and
- factors relating to sources of information

Factors relating to clinical expertise included knowledge of leg ulcer care, recognition of symptoms of wound deterioration (including excess exudate and infection) and confidence (regarding teamwork, autonomous decision making, application of compression bandaging and in risk assessment). Factors relating to resources included time, minimising visits, ease of planning, staffing shortages and the scheduling needs of other clinical teams. Factors relating to patient preferences included social convenience, concordance, patient discomfort and the patient's ability to communicate. Finally, factors relating to sources of information included the impact of original research, journals, manufacturers' information and expert opinion.

*Conclusions:* Reapplying bandages more frequently than recommended by the manufacturers' instructions incurs significant costs in terms of both dressing materials and nursing time and may impact on healing times. The identification of the factors that affect nurses' decision making will enable the future examination of the weight of the individual factors within decision-making. This in turn will inform the design of interventions to address these issues.

**References:**

1. DiCenso A, Cullum N and Ciliska D (1998) Implementing evidence-based nursing: some misconceptions. *Evidence-Based Nursing* April 1998, 1 (2) p 38-40.
2. Iglesias C, Nelson E A, Cullum N A and Torgerson D J on behalf of the VenUS Team. (2004) VenUS 1: a randomized controlled trial of two types of bandage for treating venous leg ulcers. *Health Technology Assessment* 2004; 8 (29).

## V 41-3

**Using real clinical data to provide benchmark healing rates for venous leg ulcers**S. Brown<sup>1</sup>, P. Cooper<sup>1</sup>, L. Miller<sup>2</sup><sup>1</sup>Smith & Nephew Wound Management Division, Hull, United Kingdom,<sup>2</sup>Bamboo, Largo, USA

*Aim:* The aims are to present benchmarks of healing rates by the important prognostic factor baseline wound area and to demonstrate how individual wound clinic healing rates can be benchmarked against each other as part of a process of performance improvement.

*Methods:* Using the WoundPath™ outcomes tracking application, a large dataset of 807 patients with 1764 Venous Leg Ulcers (VLUs) has been aggregated from outpatient clinics in the US.

Benchmarks for healing rates are generated, taking into account wound area at presentation, using summary statistics, Kaplan-Meier plots and output from logistic regression models.

*Results:* Benchmark healing rates are established for the % of wounds healed through time and by week 12 in figures 1 and 2. These also quantify the prognostic effect of baseline wound area and demonstrate the need to take wound area into account whenever study results are reported or interpreted.

Figure 3 illustrates the relative performance of each clinic compared to all other clinics, after adjusting for baseline wound area. Clear differences in clinic performance were observed.

*Discussion:* Benchmarks are essential to enable the interpretation of results from clinical research (e. g. from non-comparative clinical studies) and clinical practice (e. g. in terms of assessing a wound clinic's performance).

A comprehensive set of patient, wound and treatment prognostic factors for the healing of Venous Leg Ulcers, recorded within WoundPath™ will be taken into account in generating further benchmarks.

It is only by comprehensively recording information and applying benchmarking techniques, together with information exchange and review of treatment care processes and protocols that best practice can be established and adopted.

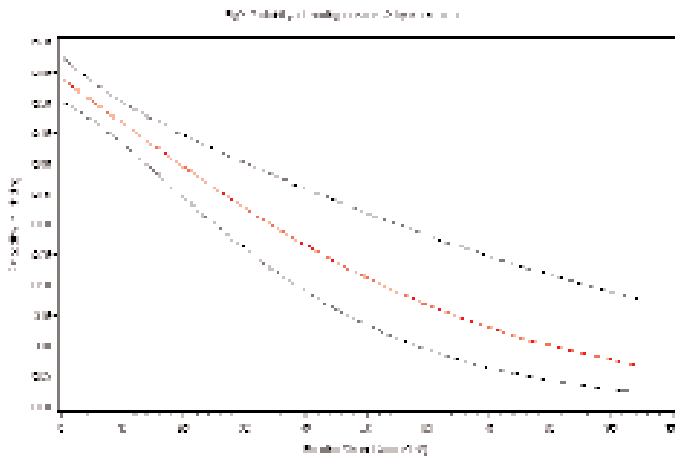


Figure 1: V 41-3

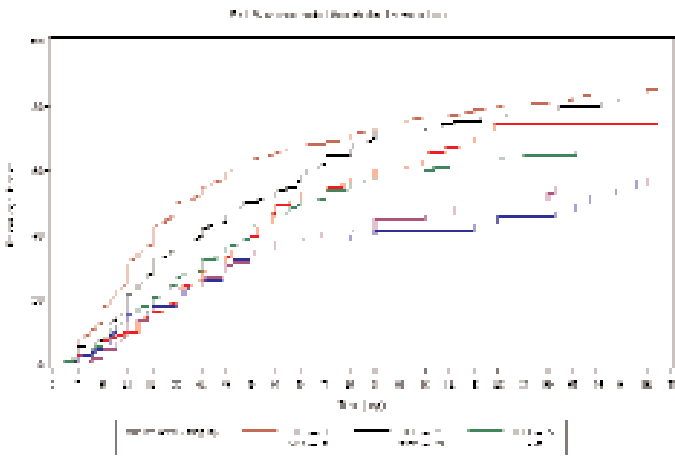


Figure 2: V 41-3

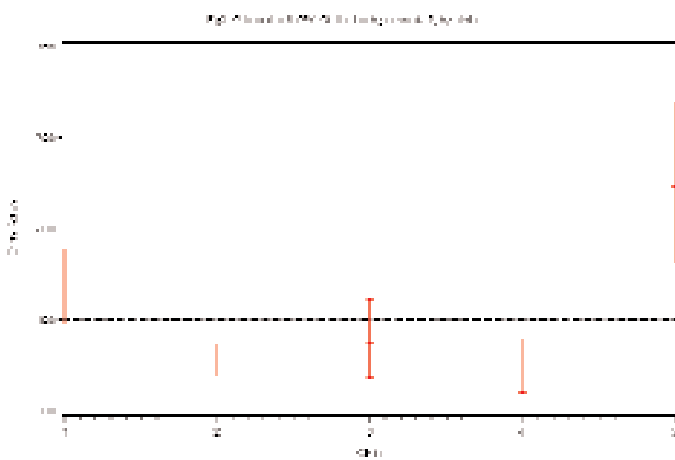


Figure 3: V 41-3

## V 41-4

## The role of colour flow duplex ultrasound and venous surgery in leg ulcer management and the prevention of ulcer recurrence

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*Aim:* To compare venous reflux as defined by colour-flow duplex ultrasonography with ulcer healing and recurrence and to see how effective surgery was at reducing ulcer recurrence over time.

*Methods:* 114 patients were identified from clinic records, 67 % with recurrent ulceration at presentation, who were initially treated with four-layer compression bandaging between June 1998 and July 2000. All were contacted to allow detailed review of their ulcer recurrence history. This data was then compared with available duplex ultrasound results, and where appropriate with surgical data.

*Results:* No correlation could be identified between the pattern or severity of superficial and/or deep reflux and the healing of the initial or any subsequent ulcer. Ulcer recurrence was however far more frequent in the two patients with deep vein occlusive disease, both patients having a history of multiple deep vein thrombosis. Confirmed complete data on ulcer recurrence was available in 78 patients. Twenty-three of these underwent venous surgery. There were 127 recurrent ulcers in the non-surgery group, 12 recurrent ulcers in the surgery group prior to surgery and only 7 after surgery. The "at-risk" periods were 4.35 years for the non-surgery group, 0.57 years for the surgery group prior to surgery and 4.3 years for the surgery group post surgery. Of the 23 patient (25 limbs) treated 12 had isolated superficial reflux and 13 had combined deep and superficial reflux, the deep reflux being limited to one deep section and less than 2 seconds in duration.

*Conclusions:* Duplex ultrasound identified that some 45% of the observed ulcer population had venous disease amenable to treatment by superficial venous surgery. Less than half of those suitable however agreed to surgical intervention. The reasons for this seemed largely related to the patient's age and associated co-morbidities. Data from the current study suggests that superficial venous surgery confers an approximate seven-fold reduction in re-ulceration risk over the study period, this protection continuing throughout the period of observation. The pattern and severity of venous reflux did not appear to influence either ulcer healing or ulcer recurrence rates unless venous out-flow obstruction was present.

## V 41-5

## Pressure and stiffness with elastic and inelastic compression materials

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*Background:* Compression therapy is very important treatment for venous and lymph disorders. It depends on the amount of compression applied and on the elastic properties of the material used. We can describe these characteristics with pressure and stiffness.

*Materials and methods:* 18 female patients (mean age 55, ± 9 years) with chronic venous insufficiency stages C1 to C4 according to CEAP classification were included. Patients were selected according to medical history, clinical examination and diagnostic criteria's (Doppler). Patients with severe diseases or those with arterial-brachial pressure index (ABPI) lower than 0,8 were excluded.

1. Patients were divided in two equal groups. In first group long-stretch (Fixit) and in second group short-stretch (Porelast) bandages were applied. The interface pressure was measured at point B in supine and standing position using the Kikuhime transducer during 12 hours. 2. The static stiffness index was calculated for both groups.

*Results:* 1. Group 1 (long-stretch): The average pressure was half an hour after application 36 mmHg and after 12 hours 33 mmHg in standing position. The average interface pressure was half an hour after application 31 mmHg and after 12 hours 28 mmHg in supine position. Group 2 (short-stretch): The average pressure was half an hour after application 55 mmHg and after 12 hours 42 mmHg in standing position. The average pressure was half an hour after application 41 mmHg and after 12 hours 20 mmHg in supine position.

2. The static stiffness index was three times higher for short-stretch bandages than for long stretch bandages.

*Conclusions:* Short-stretch compression bandages combine high pressure in standing position with a relatively low, tolerable resting pressure when lying. Comparable with long stretch compression short stretch bandages have more intense dynamic effects on venous and lymph disorders.

Hall Maritim

14.00–15.30

## V 42

## Vakuumtherapie: Quo vadis?

## V 42-1

## Einsatz des V.A.C.-Systems zur Sanierung von Frühinfekten im Bereich der Hüftendoprothetik

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*Ziel:* Infektionen in der Hüftendoprothetik können zu langwierigen und komplizierten Behandlungsprozessen führen. Ein großes Problem stellt dabei die persistierende Sekretion nach chirurgischer Revision dar.

*Methoden:* 13 Patienten (4 nach Pfannenwechsel, 3 nach TEP-Reimplantation nach Spacerausbau, jeweils 2 nach Resektionshüfte und Spacerimplantation und jeweils ein Fall nach primärer Hüft-TEP und Duokopfprothesenimplantation) mit bakteriellen Wundheilungsstörungen und persistierender Sekretion wurden einer V.A.C.-Therapie zugeführt. In allen Fällen konnte bei frustranen Sanierungsversuchen ein pathogener Keim nachgewiesen werden. Nach adäquatem Debridement und Lavage wurden periprothetisch bzw. in die Resektionshöhle jeweils 1–3 Polyvinylschwämme mit transkutaner Schlauchausleitung subfaszial eingelegt und die Wunden schichtweise verschlossen. Postoperativ wurde mit einer VAC-Pumpe ein Sog von 200 mm Hg angelegt.

*Ergebnisse:* In 12 von 13 Fällen konnte eine Infektsanierung erreicht werden. Nach 48–72 h konnte der Übergang von hämorrhagischem in seröses Sekret beobachtet werden, wonach eine Sogreduktion auf 150 mm Hg erfolgte. Nach durchschnittlich 11 [8–16] Tagen konnte bei Rückgang der Entzündungsparameter eine deutliche Sekretreduktion erreicht und die Schwämme entfernt werden. Bei unserem Therapieversager lag eine Mischinfektion aus 3 verschiedenen Bakterien und eine *C. albicans*-Stamm vor, der Infekt wurde schließlich durch die Implantation eines antibiotikahaltigen Spacers saniert. Während des weiteren stationären Aufenthaltes traten bei keinem der restlichen Patienten Komplikationen auf. Im Follow-up von durchschnittlich 20 [8–63] Monaten waren keine Infektrezidive zu beobachten.

*Diskussion:* Obwohl die V.A.C.-Therapie nicht zu den primären Therapiekonzepten beim periprothetischen Hüftinfekt zählt, bietet sie bei ausgewählten Indikationen eine wirksame Therapieoption.

## V 42-2

VAC in paediatric surgery.  
The Lucerne experience

## VAC in der Luzerner Kinderchirurgie

A. Fette

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*Aim:* After we have learnt that a vacuum covering the wound area increases granulation tissue formations as well as accelerate wound healing the general indications for the vacuum assisted closure (VAC)-technique extended steadily in all surgical disciplines, recently in paediatric surgery, too. The later a speciality in which confrontation with complex wounds is quite rare but nevertheless the broad spectrum concerning localisation and the widely variable patients' age necessitating additionally concerns about issues like being child friendly, day surgical performable as well as being a child-save dressing under full weight-bearing conditions. Therefore, we would like to report our Lucerne experience using VAC-therapy in allday paediatric surgery.

*Methods:* In the last 3 years we treated 17 children (m:f = 11:6, range 4 m to 15 y) out of our visceral and trauma surgical services as well as our plastic-reconstructive cases. For example, abdominal wall reconstruction after intraabdominal abscesses, skin closure after wide tumor exzisions, or the closure of fasciotomies after compartment syndrome respectively acute and reconstructive burn surgery. According to the indication of choice the polyvinyl- (white) or polyurethan (black) foam and the most suitable pump system (ATS, Freedom, Mini), (Kinetic Concepts Inc, San Antonio/Texas) were selected, on the one-hand for (micro-) edema release, and wound bed preparation, on the other hand for skin- or artificial skin transplant fixation or solely as entirely and perfectly fitting dressing.

*Results:* All these complex wounds could be treated reliably and successfully with the VAC technique solely or as an adjuvans. In contrast to the well-known classical techniques wound healing

was accelerated and dressing changing intervals extended. Children's comfort in wearing this dressing including better mobility was considered as excellent. Infection or leaking dressings were not reported. With new innovative (Swiss-) health care management strategies the treatment is even cost-effective.

*Discussion:* According to our experience complex wounds in paediatric surgery could be treated successfully and reliably with the VAC technique. The technique is child-friendly and cost-effective when used properly.

*Einleitung:* Nachdem nachgewiesen werden konnte, dass ein Vakuum im Wundbereich nicht nur die Bildung von Granulationsgewebe, sondern auch die Wundheilung beschleunigt erweiterte sich die Indikationstellung für die Vacuum-Assisted-Closure-Therapie in allen chirurgischen Fächern nachhaltig. So auch in der Kinderchirurgie, einem Fachgebiet, das auf den ersten Blick nur wenig mit komplexen Wunden und Wundheilungsstörungen konfrontiert zu werden scheint. Aufgrund des sehr variablen Alters der Patienten, ihrer Größe und den verschiedensten Lokalisationen der Wunden am Körper gilt es jedoch zusätzliche Parameter wie höchstmögliche Flexibilität, Kinderfreundlichkeit, (Eltern-) Compliance, tageschirurgische Applikation und sofortige kindersichere Mobilität im Verband zu berücksichtigen. Nachfolgend berichten wir deshalb über unsere Anwendererfahrungen mit der VAC-Therapie bei komplexen Wunden aus dem gesamten Spektrum der Kinderchirurgie.

*Patienten und Methode:* In den vergangenen 3 Jahren behandelten wir 17 Kinder (m:11, w:6, Spannweite 4 Mo – 15 Jahre) mit komplexen Wunden aus den Bereichen Abdominal- und Traumatologie aber auch der plastisch-rekonstruktiven Chirurgie. Exemplarisch seien genannt: Bauchwand-rekonstruktion nach septischen intraabdominellen Prozessen, Hautverschluss nach Tumorexzisionen, Verschluss von Kompartmentspaltungen oder auch akute und rekonstruktive Verbrennungschirurgie. Je nach Indikation kamen der Polyvinyl- (weißer) oder Polyurethan- (schwarzer) Schwamm und die unterschiedlichen Pumpsysteme (ATS, Freedom, Mini) der Firma KCI (Kinetic Concepts Inc, San Antonio/Texas) zur Anwendung. Einerseits zur Gewebeödemreduktion und Konditionierung des Wundbettes andererseits zur Fixation von Eigen- oder Fremdhauttransplantaten oder auch nur als sich perfekt „anschmiegender, kindersicherer“ Verband.

*Ergebnisse:* Alle diese „Problemwunden“ konnten mit der VAC Technik allein oder als vorbereitende Maßnahme erfolgreich behandelt werden. Im Gegensatz zu den bekannten „klassischen“ Techniken war die Wundheilung bei verlängerten Verbandswechselintervallen beschleunigt, der Tragekomfort bei erweiterter Mobilität im Verband ausgezeichnet. Infekte oder Verbandsundichtigkeiten traten nicht auf. Durch neue und innovative (Schweizer-) Abrechnungsmodalitäten ist die Behandlung zudem kostenneutral einsetzbar.

*Diskussion:* Nach unseren Erfahrungen können mit der VAC-Therapie auch komplexe Wunde in der Kinderchirurgie zuverlässig und erfolgreich behandelt werden. Die Technik ist sehr kinderfreundlich und mit entsprechenden Abrechnungsmodalitäten auch weitestgehend kosteneffektiv durchführbar.

## V 42-3

### Vakuumsaugtherapie als Teil einer multimodalen Therapie angioneuropathischer Wunden bei diabetischem Fußsyndrom

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*Ziel:* Die Wertigkeit der Vakuumsaugtherapie in der multimodalen Behandlung von Läsionen aufgrund eines diabetischen Fußsyndroms ist bisher nicht gesichert. Wir untersuchten deshalb Indikation, Durchführung, Komplikationen und Outcome der Behandlung mit Vakuumsaugverbänden bei Patienten mit vorwiegend angioneuropathischem Fußsyndrom und amputationsbedrohter Extremität.

*Methode:* 15 Patienten mit Typ 2 Diabetes mell., mittl. Alter  $67,2 \pm 6,4$  Jahre, mittl. Diabeteslaufzeit  $11,7 \pm 7,8$  J. wurden aufgrund bisher therapierefraktärer Wunden mit Gefährdung der Extremität mit einem Vakuumsaugverband therapiert. Erfasst wurden Demographie, Klinik, Infektionsmarker und angiologische Parameter.

*Ergebnisse:* Ursächlich für die Läsion war bei 80 % eine kritische Ischämie (mittl. transkutaner Sauerstoffpartialdruck 11 mmHg), bei 20 % lag isoliert eine Neuropathie ohne relevante Durchblutungsstörung vor. 66 % der Pat. hatten eine Läsion im Stadium Wagner III, 30 % Stadium IV. Nur 40 % der Patienten mit führender pAVK konnten revaskularisiert werden. Unter multimodalem Therapieregime (Revaskularisation, Prostanoidinfusion, Debridement und resistenzgerechter systemischer Antibiose sowie Biosurgery bei 3 Pat.) wurde im Mittel 7 Tage nach stationärer Aufnahme die Vakuumtherapie begonnen. Die mittlere Dauer der Vakuumtherapie betrug  $17,1 \pm 7,7$  Tage (4-30), ein Saugverband wurde jeweils  $4,1 \pm 1,1$  Tage auf der Wunde belassen. 60% der Patienten erhielten nach Vakuumtherapie eine plastische Deckung mittels Mesh graft. Die initiale mittl. Wundgröße betrug  $37 \pm 32$  cm<sup>2</sup>. Nach einer mittl. Krankenhausverweildauer von  $51,3 \pm 21$  Tagen wurden 22 % mit komplett verschlossener Wunde, 48 % mit guter Granulationstendenz und 30 % mit unveränderter oder schlechterer Wundsituation entlassen. 2 Patienten verstarben im Rahmen einer Majoramputation.

*Schlussfolgerung:* Bei trotz best standard care therapierefraktären, auch primär angiopathischen Wunden aufgrund eines diabetischen Fußsyndroms kann die Vakuumsaugtherapie zur Wundheilung und zum Extremitätenerhalt entscheidend beitragen

## V 42-4

## Signifikant verbesserte Einheilrate von Mesh-graft-Transplantaten bei Patienten mit Ulcus cruris durch postoperative Vakuumversiegelung

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Die Vakuumversiegelung ist eine etablierte Methode zur Förderung der Granulation akuter und chronischer Wunden im Rahmen einer modernen Wundtherapie. Aktuell existieren lediglich vereinzelte Berichte über den erfolgreichen Einsatz von Vakuumtherapien nach Hauttransplantationen. Wir berichten über ein konsekutives Kollektiv von 47 Patienten mit Ulcus cruris und insgesamt 67 durchgeführten Mesh-graft-Transplantationen. Bei 21 Transplantationen erfolgte eine postoperative Vakuumversiegelung, bei 46 Transplantationen wurde die Standardtherapie mit indifferenter Fettgaze durchgeführt. Im Kollektiv mit Vakuumversiegelung zeigte sich 10–14 Tage postoperativ eine Einheilrate von 90,4 %, im Kollektiv ohne postoperative Vakuumversiegelung betrug die Einheilrate 67,4 %. Es erfolgten weitere Analysen der Subpopulationen. Schlechtere Einheilraten konnten bei Patienten älter als 70 Jahre, mit Diabetes mellitus oder einer Dermatoliposklerose objektiviert werden. Unsere retrospektiv ausgewertete Studie zeigt erstmals eine signifikant verbesserte Einheilrate von Mesh-graft-Transplantaten bei Patienten mit Ulcus cruris durch die Verwendung einer postoperativen Vakuumversiegelung.

## V 42-5

## Tsunami: Therapy of superinfected wounds with vacuum assisted closure

### Tsunami: Die Behandlung superinfizierter Wunden mittels Vakuumtherapie

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On December 26, 2004, a giant Tsunami fanned out across the Indian Ocean. More than 300 000 people have been reported dead and millions left destitute. Shortly thereafter, airborne home transfer of most severely injured European tourists using "MedEvac" -aircraft was organized.

**Material and methods:** Seventeen severely injured tsunami victims were screened upon arrival for characteristic injury patterns. In parallel, multilocal microbiological assessment was performed to identify pathogens responsible for high level wound

contamination. Radical surgical debridements of tissue with microbial superinvasion were performed to each patient. Vacuum assisted closure (V. A. C.®) was used for local therapy and as bridging to definitely reconstruction for each severely injured patient. Open fractures were stabilized for time of treatment. Reoperation has been performed every other day.

**Results:** The predominant pattern of injury comprised multiple large-scale soft-tissue wounds (range 2 × 3 cm – 60 × 60 cm) located at lower (88 %) and upper extremities (29 %) but also on head (18 %). Additional injuries included peripheral bone fractures (47 %) and thoracic trauma with serial rib fractures (41 %) and hemopneumothorax. A major problem associated with wound management was significant contamination. Microbiological assessment identified a variety of common (*Aeromonas hydrophilia/veronii* 27 %, Enterobacteriae 36 %, Pseudomonas 54 %), but also uncommon isolates with high resistances (multi-resistant Acinetobacter and ESPL-positive E. coli 18 % each). Upper respiratory tract specimens contained an unusual high rate of multi-resistant Acinetobacter species, but also MRSA, *Aeromonas hydrophilia*, Pseudomonas and *Candida albicans*. All wounds in all regions could be treated with vacuum assisted closure. One patient died. The others were treated with reconstructive surgery.

**Conclusions:** Apparently, common local hygiene standards could not be preserved under conditions given. These isolates need to be considered when treating Tsunami patients, especially on ICU wards. Vacuum assisted closure is a helpful tool especially for local infection therapy, as bridging for definitely reconstruction and as supporting therapy of systemic anti-inflammatory treatment.

Am 26. Dezember 2004 schockierte ein gewaltiges Seebeben Süd-Ost Asien. Riesige Wellen (Tsunami) breiteten sich über den indischen Ozean aus. Mehr als 300000 Menschen starben, Millionen wurden obdachlos. Kurz danach begannen die europäischen Regierungen mit Evakuierung der schwer verletzten Touristen. Die Evakuierung erfolgte mit dem Spezialflugzeug MedEvac der Bundeswehr. Die leicht verletzten Patienten wurden nach der Landung auf verschiedene Kliniken verteilt. Die schwerverletzten Patienten kamen ins Klinikum Köln Merheim zur weiteren chirurgischen und intensivmedizinischen Behandlung.

**Material und Methode:** Die differenzierten Verletzungsmuster von siebzehn Patienten wurden bei der Aufnahme im Krankenhaus dokumentiert. Zeitgleich erfolgte ein umfassendes mikrobiologisches Screening der schwerwiegend infizierten Wunden. Bei allen Wunden erfolgte ein radikales chirurgisches Debridement. Vakuumversiegelungen wurden zur Lokalthherapie und zur Überbrückung bis zur definitiven plastischen Versorgung bei allen Patienten angewandt. Offene Frakturen wurden temporär stabilisiert. Reoperationen wurden jeden zweiten Tag durchgeführt.

**Ergebnisse:** Überwiegend traten schwere Weichteildefekte (2 × 2–60 × 60 cm) an den unteren (88 %) - und oberen (29 %) Extremitäten, aber auch am Kopf (18 %) auf. Zusätzlich dominierten schwere Thoraxtraumata mit Hämatothoraces, Rippenserienfrakturen aber auch peripheren, teils offenen Frakturen. Das Hauptproblem bestand in den schwersten Wundinfektionen. Es zeigten sich erwartete (*Pseudomonas*, Enterobacteriae, *Aeromonas hydrophilia/veronii*) aber auch ungewöhnlich hoch resistente Keimspektren (multi-resistente Acinetobacter und *E. coli*). Das Trachealsekret zeigte ungewöhnlich hohe Raten

an multiresistenten Acinetobacterarten aber auch MRSA, *Aeromonas hydrophila*, Pseudomonaden und *Candida albicans*. Alle Wunden gleich welcher Lokalisation konnten mittels Vakuumtherapie suffizient versorgt werden. Ein Patient verstarb, die anderen befinden sich in der Phase der Rehabilitation.

**Diskussion:** Normale Hygienestandards können im Katastrophenfall nicht eingehalten werden. Die Keimspektren der Opfer bestimmen in großem Umfang die weitere Behandlung und deren Erfolg. Die Vakuumtherapie stellt eine geeignete Methode dar um schwere Wundinfektionen zu beherrschen. Sie ist als bridging-Verfahren geeignet die Rekonstruktion vorzubereiten und stellt einen relevanten Beitrag zur antiinflammatorischen Therapie bei Wundinfektion getriggierter Sepsis dar.

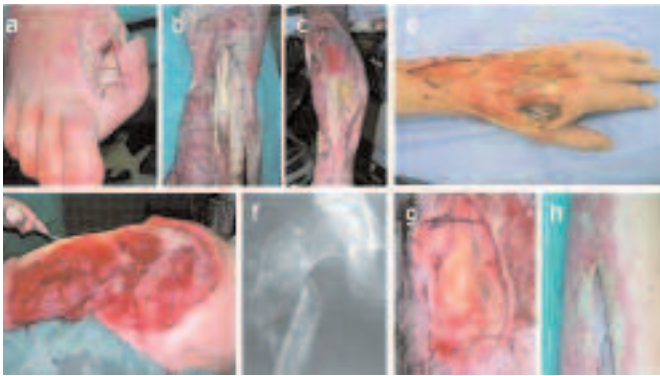


Figure 1: 42-5 Exemplarische Wunden unterschiedlicher Regionen



Figure 2: 42-5 Exemplarische Wundbehandlung mittels Vakuumtherapie

## V 42-6

### What's after VAC?

#### Was kommt nach V.A.C.-Therapie?

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**Introduction:** The vacuum assisted closure (VAC) therapy is a highly effective procedure in wound management, however, a final wound closure in terms of an epithelialisation is not possible by vacuum therapy. Due to the great daily treatment expenses of the VAC treatment, solutions for an efficient use of this therapy have to be found. Two main goals have to be achieved after initiating an efficient vacuum therapy: 1. limiting the treatment duration to the time span in which a significant benefit in wound healing can be achieved. 2. completing the initiated wound consolidation after finalizing the vacuum therapy.

**Methods:** Epithelialisation: The process of epithelialisation covered by moist dressings or "modern wound dressings" has the advantage that the patient doesn't have to undergo surgical procedures or anesthesia respectively. Another advantage is the fact that this therapy can be easily performed in an outpatient setup. Disadvantageous is the time-consuming treatment duration till a complete wound closure can be achieved. Secondary Suture: A secondary suture can be performed in local or general anesthesia according to the wound size and the distance between the wound edges. A general anesthesia will be indispensable in very large wounds or more distant wound edges, where a mobilisation of these edges has to be performed to guarantee a tensionfree wound closure. The advantages of the secondary suture are obvious a closed wound, in which usually no further therapy will be necessary. The disadvantage is the surgical re-intervention in local or general anesthesia. Skin grafting: In extensive wound areas with distant wound edges a skin graft has to be considered. This surgical procedure requires general anesthesia. In addition to this the granulating tissue should be just below the skin niveau. Advantages of this method is a fast epithelialisation depending on the adhesion of the skin graft. The disadvantage is a surgical re-intervention and the creation of a second wound at the side of the graft explantation.

**Conclusions:** In recent years the VAC treatment has been established as treatment option for acute and chronic wounds, nevertheless this wound management doesn't lead to a complete closure of the wound. The subsequent procedure to finalize wound closure are epithelialisation, secondary suture and skin grafting. The appropriate treatment should be chosen according to the patients individual needs and the characteristics of the wound itself.

**Einleitung:** Die Vakuumtherapie ist in der Wundbehandlung ein höchst effektives Verfahren, allerdings ist ein endgültiger Wundverschluss im Sinne einer Epithelisierung aus technischen Gründen unter Vakuumtherapie nicht möglich. Da die Vakuumtherapie jedoch hohen Tagestherapiekosten unterliegt, müssen für einen wirtschaftlichen Einsatz Wege gefunden werden, diese Therapie nach Ausnutzung ihrer Vorteile zum einen möglichst rasch zu beenden und zum zweiten die begonnene Wundkonsolidierung abzuschließen.

**Methodik:** Prinzipiell kommen 3 mögliche Verfahren zum Abschluss der Wundheilung nach Vakuum-Therapie in Betracht, deren Vor- und Nachteil sowie mögliche Indikationen hier erläutert werden sollen:

1. Epithelisierung: Das Abwarten der Epithelisierung unter feuchten Verbänden oder sog. „Modernen Wundauflagen“ (z. B. Hydrokolloid- oder Polyurethan-Verbände) birgt den Vorteil in sich, dass sich der Patient keiner operativen Intervention bzw. Narkose unterziehen muss und dass diese Therapie problemlos ambulant durchgeführt werden kann. Nachteil ist eine relativ lange Dauer bis zum endgültigen Wundverschluss.

2. Sekundärnaht: Eine Sekundärnaht kann je nach Wundgröße und Abstand der Wundränder in Lokalanästhesie oder Teil- bzw. Vollnarkose durchgeführt werden. Für einen Verschluss in Lokalanästhesie kommen Wunden in Frage, die einen geringen Abstand (ca. 1–2 cm) zwischen den Wundrändern aufweisen und deren Längenausdehnung so beschaffen ist, dass die Höchstdosis an Lokalanästhetikum nicht überschritten wird. Eine Narkose kann notwendig werden bei entweder sehr großer Wunde oder weit auseinander liegenden Wundrändern, da hier eine Mobilisation

der Wundränder zum spannungsfreien Wundverschluss notwendig wird. Vorteil der Sekundärnaht ist eine verschlossene Wunde, die in der Regel keiner weiteren Therapie mehr bedarf. Nachteil ist eine erneute „Operation“ entweder in Lokalanästhesie oder unter Teil-/Vollnarkose.

3. Hauttransplantation: Bei großflächigen Wunden mit weit auseinanderliegenden Wundrändern kommt eine Hauttransplantation in Betracht. Diese kann nur in Allgemeinnarkose durchgeführt werden. Zudem sollte das Granulationsgewebe bis knapp unter das Hautniveau reichen. Vorteile dieses Verfahrens sind eine schnellere Epithelisierung in Abhängigkeit vom Anwachsen des Transplantates. Nachteile sind ein erneuter operativer Eingriff sowie das Setzen einer zweiten Wunde an der Entnahmestelle.

**Schlussfolgerungen:** Die Vakuumversiegelung hat sich in den vergangenen Jahren als Behandlungsverfahren akuter und chronischer Wunden etabliert, führt jedoch nicht zum vollständigen Wundverschluss. Die hierfür notwendigen Verfahren, nämlich Epithelisierung, Sekundärnaht oder Hauttransplantation sollten in Abstimmung auf die Bedürfnisse der Patienten sowie anhand der aufgeführten Wundcharakteristika gewählt werden.

## V 44

### Pressure Ulcers

#### V 44-1

#### Does new technology in alternating pressure air mattress systems improve performance

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<sup>2</sup>Delft University of Technology, Faculty of Industrial Design, Delft, Netherlands,

<sup>3</sup>Salford NHS Trust, Department of Care for the Elderly, Salford, United Kingdom

**Introduction:** With the emphasis placed on evidence based health care, and cost effectiveness, it is essential that clinicians are provided with research evidence to assist them in equipment selection. Whilst field based outcomes are considered the gold standard, surrogate measures do provide an indication of physiolo-

gical performance. Previous studies have reported a time-based technique [1] for analysing the ability of alternating pressure air mattresses (APAMs) to relieve pressure and have demonstrated that different system designs produce variable results. This study used the same technique to measure the performance of two recently updated APAMs, the Nimbus logic 200 (Huntleigh Healthcare Ltd) and the Duo 2 (Hill-Rom Ltd) when compared to their predecessors [2] Nimbus 3 and Duo respectively.

**Methods:** Sixteen healthy volunteers participated in the study. Interface pressure (IP) measurements were carried out under the sacrum, heel and left trochanter using the Oxford Pressure Monitor (Tally Group Ltd). Data was analysed using the Student t-test or the Mann Whitney U-test. Results were considered statistically significant when  $p < 0.05$ .

**Results:** The Duo 2 system demonstrated a significant improvement in IP compared to its predecessor during deflation phase of the alternating cycle. However the mattress did not achieve pressures below 30mmHg and demonstrated lesser performance in terms of pressure relief index (PRI) on the sacrum at

the arbitrary thresholds of 30, 20 and 10 mmHg when compared to the original Duo system. The Nimbus logic system demonstrated significant improvements over the Nimbus 3 in PRI below 30, 20 and 10 mmHg thresholds on the heels, and below 30 and 20 mmHg on the sacrum, but there was no change at the trochanter.

**Conclusions:** The Nimbus logic mattress replacement system improved pressure relieving performance significantly in five out of nine areas, whilst the Duo 2 system decreased in three when compared to the older Duo system. Whilst this study identified significant differences in interface pressure relieving performance between the products, the relationship between interface pressure measurement and clinical outcomes is as yet unclear.

### References

1. **Rithalia, SVS, Gosalkorale, M.** Journal of Rehabilitation Research and Development 1998;35:225-230.
2. **Rithalia, SVS.** Journal of Tissue Viability 2004;14:51-58.

## V 44-2

### The „team strategy“ in the treatment of the multiple pressure ulcers in the patients after spinal cord injury

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The authors describe their experience about 195 patients joints to our observation in our Spinal Cord Unit after spinal cord injury, for pressure ulcers in period 1999-2004, 85 of these introduced 2 or more ulcerative lesions (until to a max of 6 ulcers contemporary).

**Materials and methods:** We consider in our presentation 74 patients males and 11 females of medium age of 40 years (range 22-72 years) affections from multiple pressure ulcers (from 2 to 6), for a total of 255 lesions and for which analogous to how much we carry out for the simple lesions, it comes established, 7-10 days before the intervention, one adapted to nutrition for I.V. way with caloric contribution from 1830 to 2550 kcal to second of the necessities of the patient in considerations of controls of the weekly estimated nutritional parameters, continuing the infusion for all the post-operative period. It comes carried out a colturale biopsy of every wounded and begun one specific antibiotic therapy aimed 2 days before the participation maintaining it in order at least 15 days, moreover the patient and subordinate to prevention of deep the venous thromboses with eparine to low molecular weight from the day of the participation. The surgical treatment (135 intervention), when possible, it has been

carried out without anaesthesia, using miocutaneous flaps that give one cover of adapted thickness and carrying out closings at least two ulcers contemporary. The post-operative passed one has happened on a fluidised bed, and subsequently a period of weaning on bed to air. To obtained our goal the patients have begun a training in wheel chair for increase times them with recovery of the ADL to the aim to guarantee one good resumption of the autonomies, and one postural study with computerized control of the sitting to the aim to reduce the recurrence that they are monitored in the follow up (2 - 4 - 6 - 12 - 18 - 24 months).

**Results:** All the patients have obtained the complete clinical resolution and the resumption of the ADL in wheel chair with medium hospitalisation of 90 days (ranges from 45 to 180 days). In four lesions the surgical review of the wounds has been necessary, for marginal necroses of the edges of the wound with successive clinical resolution. The follow up of the patients it is in average of 40 months (range from 6 to 60 months) has put in evidence 6 recurrence.

## V 44-3

### Pressure trial: Cost effectiveness analysis of two alternating pressure surfaces for the prevention of pressure ulcers.

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**Objective:** To compare the cost-effectiveness of alternating pressure mattresses replacements (APR) and alternating pressure mattress overlays (APO) for pressure ulcer prevention in hospital patients.

**Methods:** A cost-effectiveness analysis was performed using patient level data from the 1971 participants in a multicentre randomised controlled trial comparing alternating pressure mattress replacements (APRs) and alternating pressure mattress overlays (APOs) for pressure ulcer prevention (the PRESSURE trial). Acute and elective patients aged 55 years and over admitted to vascular, orthopaedic, medical or care of the elderly wards from 11 UK hospitals were eligible for inclusion if their expected hospitalization period was 7 days or longer; and they had (or were expected to have) limited physical activity for 3 days or more. The perspective for the economic analysis was that of the UK National Health Service (NHS) and Personal Social Service. The time horizon for the analysis was length of stay in hospital. Health benefit was measured as the difference in mean time to pressure ulceration (pressure ulcer free days).

**Results:** Restricted Kaplan Meier estimates of mean time for the development of a pressure ulcer indicated that patients allocated APRs developed a pressure ulcer 10.64 days later (95 % CI 24.40 to 3.09) than those on APOs. Adjusted estimates of mean total treatment hospital costs also favoured APRs. On average the hospital treatment of patients allocated to APRs cost

£74.50 less, (95 % CI 368.21 to £517.21) than that of patients allocated to APOs. These results were robust to variations in the provision of alternating pressure relieving surfaces to hospitals (rental rather than purchase) and the life span of the surfaces.

**Conclusions:** APRs are a dominant alternative when compared with APOs, i.e. on average alternating pressure mattress replacements are associated with greater health benefits and lower costs than alternating pressure overlays.

## V 44-4

### Pressure trial clinical and patient outcomes

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**Introduction:** The objective of the Pressure Trial was to determine whether there are differences between alternating pressure mattress overlays and alternating pressure mattress replacements. The primary endpoint was the development of a new pressure ulcer of at least Grade 2; secondary endpoints included time to pressure ulcer development and patient acceptability.

**Methods:** We conducted a multi-centre, randomised, controlled, parallel group trial in 6 NHS Trusts and involving 11 hospitals. The target population consisted of patients aged at least 55 years admitted to vascular, orthopaedic, medical or care of the elderly wards, either as acute or elective admissions, in the previous 24 hours. Randomisation was via an independent, secure 24-hour randomisation automated telephone system, ensuring allocation concealment. Patients were randomised between alternating pressure mattress replacements and alternating pressure mattress overlays.

**Results:** Of 6155 patients assessed for eligibility a total of 1972 participants were randomised (990 to overlays and 982 to replacements). 106 (10.7 %) overlay patients and 101 (10.3 %) replacement patients developed one or more new Grade 2 pressure ulcers. The difference in the proportions of patients with a new pressure ulcer (overlay – replacement) was 0.4 % (95 % CI: -2.3 % to 3.1 %). In the adjusted analysis using the intention to treat population, the odds ratio for developing a new pressure ulcer on overlay compared with replacement was 0.94 (95 % CI: 0.68 to 1.29,  $p = 0.70$ ). Median time to development was 56 days (95 % CI: 48 days, upper limit not estimable) for the replacement group and the median for the overlay group had not been reached ( $p = 0.76$ , log-rank test). More overlay patients requested mattress changes due to dissatisfaction (23.3 %) than replacement patients (18.9 %,  $p = 0.02$ ).

**Conclusions:** There was no difference between alternating pressure mattress replacements and alternating pressure mattress overlays in terms of the proportion of patients developing new pressure ulcers, however mattress replacements were more acceptable to patients.

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## V 44-5

### Pressure care in hospital settings: Clinical research nurses' observations

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**Introduction:** The development of pressure ulcers can be associated with a combination of both intrinsic and extrinsic factors. One important extrinsic factor is the failure of risk assessment and appropriate management. This study explores the perceptions and observations of pressure ulcer care from a group of Clinical Research Nurses (CRNs) observing care provided in acute hospital wards in 5 UK NHS Trusts.

**Methods:** A focus group was carried out with 9 CRNs participating in a multi-centre trial of pressure area care. The focus group offered an opportunity for CRNs to share their perceptions and observations of the quality of pressure area care. The CRNs had been ideally placed throughout the trial period as informal participant observers. The focus group was analysed using content analysis (following the broad principles of analytic induction) and process analysis of the group interactions.

**Findings:** CRNs identified areas of inadequate treatment, management and care. They reported that organisational and clinical aspects of care delivery compromised pressure area care. They commented that skin integrity was often given low priority outside care of the elderly wards; senior staff were often unaware that patients had pressure damage; there was an increasing reliance on unregistered staff to provide bedside care; and there was inadequate documentation of pressure care. In addition, they reported that the dangers of chair-sitting for 'at risk' patients were often not recognised; there was a lack of understanding amongst staff in relation to pain and discomfort experienced by patients; there was a lack of appropriate pressure relieving equipment available in wards; and that pressure ulcers of Grade 2 (i.e., broken skin) were often not dressed. Lastly, there was a perception that good clinical leadership from senior ward nurses had a large impact of the quality of care.

**Discussion:** CRNs' observations as to the quality of pressure area care and management in acute hospital wards requires attention. Nurses have a key role in influencing care provision and can address areas of poor practice to minimise the effects of extrinsic factors in the development of pressure ulcers and to improve treatment and management.

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## V 44-6

***Pressure ulcer prevalence goes down  
and prevention up – successful  
implementation of a care programme for  
hospitals and communities***

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*Aim:* To compare prevalence and prevention before and after implementation of a care programme in hospitals- and communities in an urban setting.

*Methods:* Prevalence of pressure ulcers and preventive actions were measured utilizing the EPUAP prevalence protocol in two major hospitals, two geriatric departments and homes for the elderly in seven communities. Together with the protocol, a pressure ulcer classification card including colour pictures of grade 1–4 ulcers was distributed. On the back side of this card, the Modified Norton Scale was printed. The study was repeated after one year. During that year, 495 nurses were educated and a care-program was introduced. The organization of the study included leading nurses in communities as well as in the hospitals. The study was approved by the Ethics Committee.

*Results:* Six thousand patients participated in the two studies. At one hospital, the prevalence rate fell from 12,7 % (2003) to 8,6 % (2004). Minor differences were seen in the geriatric departments. However, in the communities the effect was most dramatic- one home for the elderly reduced their prevalence from 50 % to 8 %. The total difference in prevalence between 2003 and 2004 was  $p = 0.009$ . The difference in grade 2–4 ulcers was  $p = 0.02$ . Significant increase in total preventive activities was noticed between 2003 and 2004 ( $p = 0.0001$ ). Fast feedback to each unit and focussed education resulting in introduction of regular risk assessment and prevention program were probable reasons for the dramatic reduction in pressure ulcers. In the new communities who joined the study in 2004, 40 % of the patients were at risk of developing pressure ulcers (Modified Norton < 20).

*Discussion:* The successful implementation of a care-programme for prevention and treatment of pressure ulcers, measured with the EPUAP-prevalence instrument after one year has been extremely encouraging. It was calculated that a reduction of 50 % of pressure ulcers in the County represents a cost saving of 1,5 to 2,8 million Euros per year. The close cooperation between leading nurses over organizational borders was a prerequisite for the success of the studies.