
REVIEW

THE MANAGEMENT OF PRESSURE ULCERS - QUALITY IMPROVING FACTOR AND RAPID RECOVERY STRATEGIES

GEORGETA PĂUNICĂ-PANEA^{1,2}, F. POPA^{1,2}, M.C.T. DIMITRIU^{1,2}, M. BANACU^{1,2}, N. BACALBAȘA², INA POPESCU¹, A.C. CARAP^{1,2}, SIMONA BOBIC^{1,2}, MONICA NEAGU³, V.D. CONSTANTIN^{1,2}

¹Department Surgery, "St. Pantelimon" Hospital Emergency, Bucharest, Romania

²University of Medicine and Pharmacy "Carol Davila" Bucharest, Romania

³Immunobiology Laboratory "Victor Babeș" National Institute of Pathology

SUMMARY

Decubitus ulcers are lesions of the skin and underlying tissue resulting from the constant, long term pressure applied to a protruding bone. Given the difficulties with treating eschars, bedsores are a classic example of "better prevent than treat". The first step in eschar prevention is to calculate the risk for development - the Norton scale is the easiest to use with acceptable results (66% accuracy). As a preventive measure to eschar formation, air mattresses are more effective than foam or classical mattresses; also repositioning the patient every 4 hours is acceptable in terms of time efficiency. Depending on the score obtained using the Norton scale, other measures can be employed: keeping the skin clean and dry (as close to physiologic as possible), employing quick intervention when we observe degeneration of skin status by improving skin perfusion and maintaining good patient nutrition and hydration. After their development, evaluation of bedsores according to EPUAP (The European Pressure Ulcer Advisory Panel) is very important in deciding the subsequent treatment needed. Treatment of bedsores, regardless of their classification, requires reducing the local bacterial load by disinfection and possibly debridement of necrotic tissue; furthermore we can reduce the risk of contamination by choosing the most appropriate dressing and the frequency with which is replaced. Ulcers classified by grades 1 or 2 may be treated conservatively, while grade 3 or 4 ulcers require surgical approach. The applications of negative pressure, hyperbaric oxygen therapy, the use of cytokines or stem cells are just a few innovative alternates.

Key words: decubitus ulcers; repositioning; dressing; debridement

RÉSUMÉ

La gestion des escarres - facteur de croissance de la qualité des soins et d'une récupération rapide

Les ulcères de décubitus sont des lésions de la peau et du tissu sous-jacent, résultant de l'ischémie tissulaire et de la pression constante et permanente faite par un plan dur sur un os en saillie. Compte tenu de la difficulté avec laquelle elles sont traitées, les escarres sont un cas classique de "mieux prévenir que de traiter." La première étape vers la prévention des escarres calcule le risque d'apparition. À cet égard, l'échelle de Norton est plus facile à utiliser et les résultats sont acceptables (précision = 66%) ce qui la recommande pour maintenant, étant le plus utilisé. Comme mesure préventive à utiliser pour les escarres, le matelas d'air est plus efficace que l'utilisation de matelas classique ou en mousse, et un repositionnement classique du patient à 4 heures étant acceptable en termes d'efficacité. Selon le score obtenu par les patients sous l'échelle de Norton, l'utilisation d'une ou plusieurs mesures d'accompagnement sont absolument nécessaires afin de prévenir les escarres, telles que: garder la peau propre et sèche (sous réserve proche de la normale), de prendre des mesures rapides quand on observe une dégradation de l'état de la peau, l'amélioration de la perfusion de la peau et d'éviter la malnutrition. Après leur développement, l'évaluation des escarres selon EPUAP (The European Pressure Ulcer Advisory Panel) est très importante pour déterminer quel traitement sera appliqué plus tard. Pour le traitement des escarres (quel que soit le classement), il faut d'abord réduire la charge bactérienne locale par la désinfection et éventuellement la détersion des tissus nécrosés et ensuite de réduire le risque de contamination par le choix optimal de l'habillage des plaies de pression et de la fréquence avec laquelle il est remplacé. Le traitement des ulcères classés degré 1 et 2 peut être conservateur dans le premier cas, tandis que ceux qui sont classés 3 et 4 ont indication chirurgicale. L'application d'une pression négative, l'oxygénothérapie hyperbare, l'utilisation de cytokines ou de cellules souches ne sont que quelques méthodes innovatrices dans le domaine.

Mots-clés: ulcères de décubitus, repositionnement, pansement, débridement

Correspondence address:

Georgeta Păunică-Panea, PhD

Department Surgery Hospital Emergency, "Sf. Pantelimon" Bucharest

Pantelimon Ave., 340-342, 1st floor, Bucharest, Romania

e-mail: paunica_laura@yahoo.com

INTRODUCTION

Pressure eschars (ulcers) are lesions of the skin and underlying tissue resulting from the constant, long term pressure applied to a protruding bone. Skin is less prone to pressure sores so the external appearance is in many cases deceptive, leading to underestimating the severity of the lesion [1]. Although this pathology is known for over 5000 years, since the time of Ancient Egypt, prevention and treatment of pressure sores remains a challenge [2]. Given the difficulties with treating eschars, bedsores are a classic example of “better prevent than treat”.

METHODS

The study aims to highlight a few recent approaches to pressure sores treatment and also reviewing the classical ones. We studied the PubMed, Cochrane and Uptodate databases and we analyzed the result of the clinical trials and reviews published since the year 2000.

Prevention

Decubitus ulcer prevention is the most cost/effective approach. To encourage prevention of pressure ulcers, starting with the year 2008, hospitals in the United States of America are not funding the medical care necessary for treatment of grade 3 and 4 eschars during hospitalization. [3]

Prevention of bedsores begins by quantifying the individual risk of development, and it starts by obtaining a rigorous medical history and a thorough physical examination that will reveal potential pathologies and risk factors for developing pressure ulcers.

Pressure distribution of body weight implies using surfaces capable of reducing pressure associated with correct patient positioning.

- Area of support - in recent years a number of special anti-eschar mattresses have developed

Foam mattresses have the main purpose of reducing contact pressure and have a proven benefit compared to classic mattresses.

Dynamic air mattresses have the advantage of keeping the skin dry and reduce contact pressure – a large number of micro pores “injecting air” reduce humidity thus inhibiting the growth of bacteria; also the mattress reduces pressure by dispersing the body weight.

Static air mattresses are multi-chamber mattresses, which adjusts the air pressure in each chamber depending on body weight, balancing the tension exerted on virtually every body segment. A study conducted on a lot of 1074 patients from 12 hospitals in China, comparing the two types of mattresses concluded that the effectiveness of the two in term of preventing pressure ulcers is similar; it’s also worth mentioning that during the study patients were repositioned two times a day. [4]

- Positioning and repositioning the patient forms part of the preventive measures of pressure eschars;

although these principles are well known, there are very few papers that describe these procedures and their effectiveness. [5]

- Placing pillows between knees and ankles
- Special attention is given to heels – pillows will be placed underneath the heels to relieve pressure.
- Lateral decubitus relieves pressure on the great trochanter by placing the patient at an angle of 30 degrees

The aim of repositioning is to maintain the microcirculation on the pressure point.

Although some studies show reduced incidence of pressure ulcers when repositioning the patient every two hours compared to three hours; studies didn’t show a significant difference when repositioning the patient every two hours in lateral decubitus and every 4 hours supine compared to repositioning the patient every 4 hours each position. [6], [7] The standard procedure of repositioning the patient is every two hours, especially if the patient is lying on a standard mattress.

- Supportive therapy – Besides correct positioning and repositioning of the patient and the use of special mattresses there are a series of other important measures for the immobilized patient

Verifying the tissue status daily – observing the color, turgor, local temperature, and integrity.

The skin should be kept dry and clean – hence the importance of fecal and urinary incontinence management using neutral pH cleaners [5], [8]. In turn, excessively dry skin is a problem that can be avoided using formulas based on hyper oxygenated fatty acids. A double blind study carried on a lot of 331 patients concluded that the use of such formulas reduces the incidence of pressure ulcers compared to placebo from 17.37% TO 7.32%. [9]

Improving skin perfusion is another important predictive factor for the prevention of pressure sores – it is well known that hypo perfused areas are prone to developing such lesions. Thus measures will be taken to address hypotensive patients, and if necessary treating arterial obstructive disease and also avoiding vasoconstrictors. [10], [11]

Another important factor to consider is malnutrition that should be addressed appropriately – implying enteral or parenteral nutrition. Recent studies show the efficacy of preventing pressure ulcers by correcting malnutrition based on a protein intake of 1.2-1.3 mg/kg of body weight [12] and caloric intake of 37.9+/- 6.5 kcal/ kg/ day [13].

Risk assesment

To apply the preventive measures described above we need a standard evaluation of the risk for developing pressure eschars. To meet this need, Doreen Norton and associates developed the Norton Scale (table 1), which along with Waterlow scale and Braden scale, are still the most used in the field.

The Norton scale is easy to use, even for the less experienced, with a specificity of 59%, 81% sensibility and 66% accuracy. [14]

Table 1 - Norton scale

FACTOR/SCORE	4	3	2	1
PHYSICAL CONDITION	GOOD	MODERATE	BAD	VERY BAD
MENTAL STATE	ALERT	APATIC	CONFUZE	UNCONSCIOUS
ACTIVITY	WALS ALONE	NEEDS HELP WALKING	WHEELCHAIR	IMMOBILIZED TO BED
MOBILITY	GOOD	MODERATE	BAD	IMMOBILE
CONTINCE	CONTINENT	OCCASIONAL	URINARY	FECAL AND URINARY INCONTINENCE

Waterlow scale is more complex, calculating the eschar development risk depending on BMI, aspect of the skin, gender, age, fecal and urinary continence, mobility, appetite, neurologic deficit and other specific risk factors. Its use often leads to an overvaluation of risk. Studies in literature describe 61% specificity, 63% sensibility and 77% accuracy associated with using the Waterlow scale [2], [14].

Braden scale is considered by the profile literature as having the best specificity – 100% and 53% specificity. [14]

There are studies in progress that aim to improve sensibility and specificity of evaluating the risk for developing pressure eschars (Nursing Needs Score) but there is no evidence regarding their superiority compared to the classic scores.

Evaluating pressure ulcers

Staging pressure ulcers is very important for the medical personnel, for initiating the proper treatment according to the degree of the lesions. The most widely used classification systems of bedsores are EPUAP (The European Pressure Ulcer Advisory Panel) and NPUAP (National Pressure Ulcer Advisory Panel), both describing 4 degrees of injuries; neither of the two has shown to be superior in predicting the outcome and management of bedsores.

EPUAP staging

- Grade 1: superficial ulcers, the skin remains intact with erythema, edema and induration
- Grade 2: may appear as blisters or open sores – loss of substance involving epidermis and/or dermis
- Grade 3: characterized by loss of substance involving skin and subcutaneous tissue, the lesion involves the muscle and fascia
- Grade 4: most severe and are characterized by muscle, tissue damage and in some cases even bone. Infectious risk of these pressure ulcers is high, causing sepsis or osteomyelitis.

Treatment

The treatment of pressure ulcers can begin only after

the degree of the lesion is established. In grade 1 and 2 ulcers the management is conservative, while grade 3 and 4 ulcers need surgical treatment. Whatever the degree of the lesion the causing factor should be addressed.

The first step in treating any local pressure ulcers is decreasing bacterial load by disinfection and in some cases debridement of necrotic tissue. Necrotic tissue debridement can be obtained by classic surgical removal; modern mechanical methods can be used - applying hydroactive bandages, removing debris using high pressure water jet, ultrasound or laser therapy. [16]

Other modern techniques reviewed in literature include enzymatic methods – that liquefy the necrotic tissue and enable its removal along with the dressing; the superiority of these methods has not been established by studies yet, although studies have shown a faster healing by stimulating angiogenesis and epithelization using collagenase. [17]

Biological debridement using maggots - the photolytic enzymes secreted by the maggots liquefy the necrotic tissue and after consume it and thus will clean the lesion without damaging healthy tissue; worms have an important antibacterial role releasing bactericides and thus accelerating the healing process. [18] Although this therapy has demonstrated its utility in several studies, there is reluctance on part of the patients and medical staff for using it.

Choosing the right dressing and the frequency of changing it is a very important step in eschar management. Weather the dressing used is water based, gel or calcium arginate – there are several common properties – protecting the lesion from contamination, absorption of the exudates – thus accelerating the healing process by avoiding underlying tissue maceration.

Modern dressings

- Hydrocolloid dressings – contain a gel that speeds development of new epithelial cells, while maintaining the surrounding healthy tissue dry
- Alginate dressings – based on algae with high content of sodium and potassium; can associate honey
- Dressings based on acetic acid – used to destroy microbial biofilm by local pH change – antibiotic use grows bacteria resistance [16]

Table 2 - Interpretation of Norton scale

Score	> 18	14-18	10-14	< 10
Risk	Low	Medium	High	Very high

- Dressing with lyophilized animal collagen
- Collagen sponges with gentian violet and lidocaine
- Dried powder containing poly-2-hydroxyethylmethacrylate, poly-2-hydroxypropyl methacrylate and sodium deoxycholate
- Hemoglobin based spray

Pressure ulcer treatment by applying negative pressure is a new approach, the benefits of which have been described in many studies. Its main advantages are: increasing local blood flow reduces the swelling and speeds up the formation of granulation tissue [19], while maintaining graft viability.

Regarding hyperbaric oxygen therapy, many studies have been published demonstrating the efficiency regarding angiogenesis, decreasing inflammation and edema, decreasing pain, increasing the immune response, improving lymphatic circulation and stimulating bone mineralization, improving peripheral nerves sensitivity [20]; other studies have highlighted the adverse effects of this therapy that included seizures and pneumothorax. [21]

Cytokines and growth factors – in particular PDGF, FGF, GM-CSF – platelet-derived growth factor gel (becaplermin) is a product marketed in the U.S. to stimulate cellular proliferation and angiogenesis [22] but there are post-marketing studies that have shown an increase in mortality due to malignancy in patients treated with this product for a period longer than 3 months [23]. Epidermal growth factor and granulocyte macrophage colony stimulating factor (GM-CSF) are used predominantly for venous ulcerations in order to speed up healing.

Skin grafts (obtained by bioengineering) although used predominantly in treating various skin defects of the dermis – can be used for pressure ulcer management as they induce neovascularization and fibroplasia even if the underlying tissue is poorly vascularized. Their use in ulcerated lesion is difficult because of the infection and the massive exudates which prevent adequate graft integration. [16]

Stem cell therapy – using either mononuclear cells originating from the bone marrow or adipocytes – in order to repair, replace and restore biological function of the affected organ or tissue. Mononuclear cells from the bone marrow stimulate neoangiogenesis and through paracrine secretion they recruit macrophages and endothelial cells that speed up wound healing. [24]

Transplantation of autologous adipose tissue – some studies show good results in early stage ulcers because of the regenerating properties. Tangible results appear in terms of increasing skin thickness and the subcutaneous tissue, repairing the continuity of the skin, improving texture and elasticity and even subcutaneous tissue vascularization growth. [25]

Omega 3 acid ethyl esters – oral administration has proven effective in cases of ulcers refractive to therapy. They are used as food supplements administered after meal once a day. They are believed to improve blood supply; they suppress the action of inflammatory cytokines and leukocyte chemotactic factors, thus favoring the healing process. [26]

Sometimes, severe ulcers (grade 3 or 4) don't heal using the methods described above and require surgical manage-

ment. Surgical techniques vary from simple closure of the wound (when possible – extensive lesions will strain the wound edges if sutured), skin graft application, tissue flap or free transfer of tissue.

The skin graft should be used in case of superficial ulcers, without exposure of vessels, nerves, tendons or bone and can gain a rich vascularized basis.

Skin flaps should be used in deep ulcers to cover the defect after its excision. If there is no possibility for creating local flaps, regional flaps can be used. Microvascular free flaps are used less frequently, but are extremely useful in cases where local or regional ones are not available or did not fix the defect.

Although surgery is effective, it must take into account the potential complications such as infections (even osteomyelitis), abscess, graft necrosis, hemorrhage or deep vein thrombosis.

CONCLUSIONS

Although pressure ulcers are a well known pathology, described thousands of years ago, we still use treatment principles used in Ancient Egypt (for example the use of honey). Modern technology improves detection and management of pressure ulcers, which lead to an improvement of the patient's quality of life. Pressure ulcer management comprises all the steps from the risk evaluation of developing ulcers to the final steps of applying the appropriate treatment that ultimately leads to healing.

REFERENCES

1. Bauer J, Phillips LG. Clinical staging and management of pressure ulcers. *Plast Reconstr Surg*.2008;121(1suppl):1 [PubMed]
2. Karoon Agrawal, Neha Chauhan. Pressure ulcers:Back to the basics. *Indian J Plast Surg* 2012 May-Aug;45(2):244-254 [PubMed]
3. Bennet RG, O'Sullivan J, DeVito EM,Remsburd R. The increasing medical malpractice risk related to pressure ulcers in the United States. *J AM Geriatr Soc* 2000; 48(1):73 [PubMed]
4. Qixia Jiang, Xiaohua Li, Jiandong Wang,. Multicenter comparison of the efficacy on prevention of pressure ulcer in postoperative patients between two types of pressure-relieving mattresses in China. *Int J Clin Exp Med* 2014;7(9):2820-2827[PubMed]
5. Dan Berlowitz, Prevention of pressure ulcers.[uptodate]
6. The effect of various combinations of turning and pressure reducing devices on the incidence of pressure ulcers. Defloor T, De Bacquer D, Grypdonck MH, *Int J Nurs Stud*.2005 Jan; 42(1):37-46[PubMed]
7. Effectiveness of turning with unequal time intervals on the incidence of pressure ulcer lesions. Vanderwee K, Grypdonck MH, De Bacquer D, Defloor T. *J Adv Nurs*.2007 Jan; 57(1):59-68[PubMed]
8. Pressure ulcer prevention. An evidence-based analysis. Ontario Health Technology Assessment Series 2009; Vol.9, No.2 [PubMed]
9. Torra I Bou JE, Segovia Gomez T, VerduSorianoJ, Nolasco Bonmati A, Rueda Lopez J, Arboix I PerejanoM.The effectiveness of a hyperoxygenated fatty acid compound in preventing pressure ulcers. *J Wound Care*. 2005; 14 (3);117 [PubMed]
10. Bergstorm N, Braden B. A prospective study of pressure sore risk among institutionalized elderly. *J Am Geriatr Soc*. 1992; 40(8);747 [PubMed]
11. Schubert V. Hypotension as a risk factor for the development of pressure sores in elderly subjects. *Age Ageing*.1991;

- 20(4);255 [PubMed]
12. Thomas DR. The new F-tag 314; prevention and management of pressure ulcers. *J Am Med Dir Assoc.* 2006;7(8):523 [PubMed]
 13. Ohura T, Nakajo T, Okada S, Omura K, Adachi K. Evaluation of effects of nutrition intervention on healing of pressure ulcers and nutritional states (randomized controlled trial). *Wound Repair Regen.* 2011 May; 19 (3):330-6 [PubMed]
 14. Tabel 1. Assesment intruments for pressure ulcer risk. *Geriatrics Aging* 2006 [Medscape]
 15. Yoko Nakamura, A. Ammar Ghaibeh, Yoko Setoguchi, Kazue Mitani, Yoshiro Abe, Ichiro Hashimoto, Hiroki Moriguchi. On-admission pressure ulcer prediction using the Nursing Needs Score. *JMIR Med Inform* 2015 Jan-Mar;3(1):e8
 16. Bhattacharya S; Mishra RK, Pressure Ulcers: Current understanding and newer modalities of treatment. *Indian J Plast Surg* 215 Jan- Apr; 48(1):4-16.
 17. Demidova-Rice TN, Geevarghese A, Herman IM. Bioactive peptides derived from vascular endothelial cell extracellular matrices promote microvascular morphogenesis and wound healing in vitro. *Wound Repair Regen.* 2011;19(1):59.
 18. Sherman RA, Maggot versus conservative debridement therapy for the treatment of pressure ulcers. *Wound Repair Regen*, 2002 Jul-Aug;10(4):208-14 [PubMed]
 19. Ubbink DT, Westerbos SJ, Evans D, Land L, Vermeulen H. Topical negative pressure for treating chronic wounds. *Cochrane Database Syst Rev.* 2008;
 20. Bhutani S, Vishwanath G. Hyperbaric oxygen and wound healing. *Indian J Plast Surg.* 2012 May; 45(2):316-24.
 21. Wang C, Schwaitzberg S, Berliner E, Zarin DA, Lau J. Hyperbaric oxygen for treating wounds: a systematic review of the literature. *Arch Surg.* 2003;138(3):272.
 22. Wieman TJ, Smiell JM, Su Y. Efficacy and safety of a topical gel formulation of recombinant human platelet-derived growth factor-BB (becaplermin) in patients with chronic neuropathic diabetic ulcers. A phase III randomized placebo-controlled double-blind study. *Diabetes Care.* 1998;21(5):822.
 23. <http://www.fda.gov/Safety/MedWatch/SafetyInformation/Safety-RelatedDrugLabelingChanges/ucm121631.htm>
 24. Tang YL, Zhao Q, Zhang YC, Cheng L, Liu M, Shi J, et al. Autologous mesenchymal stem cell transplantation induce VEGF and neovascularization in ischemic myocardium. *Regul Pept.* 2004;117:3-10.[PubMed]
 25. Giovanni Francesco Maragni, Tiziano Pallara, Barbara Cagli, Emiliano Schena, Francesco Giurazza, Elio Faiella, Bruno Beomonte Zobel, Paolo Persichetti. Treatment of early-stage pressure ulcers by using autologous adipose tissue grafts. *Plast Surg Int.* 2014; 2014:817283.
 26. Kazuki Nagai, Katsuhiki Matsumaru, Ikuko Hirai, Yujiro Takae, Kazuo Andoh. New therapy using Omega 3- Acid ethyl esters for decubitus ulcers and stasis dermatitis: A case report. *Iran Red Crescent Med J.* 2014 Dec;16(120):e19500.