Wounds and wound therapy 2008

Editor
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Carita Hansson
Chairman of the Wound Healing Society Göteborg Bohus


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Wounds and wound healing

Everyone suffers from a wound at some time. Wounds range from simple abrasions to complicated difficult or slow-to-heal ulcers. Wound healing is normally uncomplicated, but in some cases the process stops and this can then cause a great deal of suffering for the individual patient and his/her relatives. Wounds that are slow-to-heal are expensive for both the patients and the community.

Wounds are classified in different ways. The terms acute and chronic have been used for many years. Acute wounds are a consequence of trauma or surgery without healing problems. Chronic ulcers are slow-to-heal because of underlying causes such as impaired circulation, or because of infections, oedema or foreign bodies. Causes that delay healing are essential to identify and eliminate.

Wound Healing Society Göteborg Bohus (WHSGB)

The interest in wound healing has increased profoundly in recent years and several wound
associations and societies have been created. In Sweden, there is the Swedish Wound Healing Society (website http://www.sarlakning.com) and there are many associations at regional levels.

The WHSGB was started in 1995 as a non-profit organisation for personnel interested in working with wounds and wound healing. In the year 2008 we are 140 members working at the Sahlgrenska University Hospital (Sahlgrenska/Möln达尔/Östra) and at other hospitals and nursing homes, as well as within the primary health care in Göteborg and southern part of the county of Bohuslän.

Since 1996, the WHSGB has regularly organised conferences two days yearly on the subject of wounds and wound healing.

The WHSGB prints guidelines” Wounds and wound therapy 2007” in Swedish which can be ordered from Westma, Sisjödepån, Datavägen 25, 436 32 Askim, fax number +46 31 682539 the number of the article is 901082. Wounds and wound therapy 2008 is also found at the following website www.sahlgrenska.se/sggb The contents are updated at regular intervals and the guidelines are continuously expanded since, as yet, not all wound related issues have been addressed.

Association for Patients with Slow Healing Wounds

An association (PASS) started 1998 for patients with chronic ulcers or slow healing wounds, and the relatives of these patients are also welcome as members. PASS has had departments in both Göteborg (PASS Göteborg) and Stockholm, but both departments have ceased to exist due to lack of members.

Self-care

To enable people with an ulcer to perform suitable self-care, information about the diagnosis, the causal mechanism and treatment is needed. On the first visit to the doctor and nurse in charge of diagnosing the type of ulcer and deciding the types of investigations and treatments needed information should preferably also give the patient both verbal and written. More printed information for ulcer patients is needed, today only available for patients with the most common types of ulcers, such as venous leg ulcers. Self-care comprises specific recommendations, like resting with the legs raised in a high position in the case of venous ulcers, as well as more general recommendations, such as quitting smoking, exercises and diet.

Author responsible: Carita Hansson

Wound-healing process
It is only during the past 20 years that we have acquired knowledge relating to the cellular background of the wound healing process which has made other treatment alternatives possible.

Wounds are normally divided into two groups, acute and chronic.

**Acute** wounds are divided into:
- traumatic wounds
- surgical wounds

**Chronic** ulcers are divided into:
- diabetic ulcers
- pressure sores/decubitus ulcers
- venous leg ulcers
- arterial (ischemic) ulcers

**Tissue regeneration**
Tissue regeneration is the ability to restore damaged or lost tissue. Most invertebrate animals and amphibians have this ability. With just a few exceptions, humans have lost the ability to regenerate tissue and human wounds instead heal with collagen scar formation. There are, however, some exceptions, including the mucous membrane and peritoneum, which heal by means of tissue regeneration, i.e. without scar formation.

**Wound-healing process**
Wound-healing is a complex biological process including several separate mechanisms, such as coagulation, cell migration, the elimination of foreign material and bacteria, the formation of new tissue and remodelling. If a wound is to heal normally, the components that are involved must be controlled, synchronised and balanced. If this interaction is disturbed, an exaggerated repair process (such as tissue hypertrophy) or a chronic ulcer can be the result.

**Chronic ulcers**
Chronic ulcers can occur in a number of different ways and they are characterised by the existence of a tissue defect that does not epithelialise. Regardless of the cause (e.g. pressure, ischemia, nutrition, infection), this is due to a disturbance in the interplay in the healing process, which leads to a breakdown in the tissue. When a chronic ulcer develops, there is always an inflammatory reaction in its surroundings, which promotes the formation of matrix-degrading proteases. If the degradation of the tissue is greater than the formation of new tissue, the size of the ulcer will increase.

**Phases of the wound-healing process**
The wound-healing process is traditionally divided into three histological phases:

1. The inflammation phase
2. The proliferation phase
3. The remodelling phase

The wound-healing process begins the moment tissue is damaged and bleeding occurs. This
bleeding initiates a coagulation cascade and platelet aggregation and a clot consisting of fibrin and platelets forms. It has the task of stopping the bleeding and protecting the injury from further bacterial contamination and fluid loss. The fibrin acts as a provisional matrix for cell migration into the defect. The platelets contain a number of different growth factors, which are released and help to attract inflammatory cells, such as macrophages and leucocytes, to the injury. This initiates the inflammation phase.

**Inflammation phase**

Inflammatory cells, such as macrophages and leucocytes, reach the injured area relatively soon after the injury occurs. These inflammatory cells secrete pro-inflammatory cytokines (such as TNF-α and interleukins) and proteases (such as elastase and collagenase). This helps to remove bacteria, dead tissue and impurities from the wound. The inflammation begins immediately after the injury and continues until the damaged area is clear of foreign material, devitalised tissue and bacteria. A provisional extracellular matrix consisting of fibrin, fibronectin and glycosaminoglycans is formed and it is progressively transformed into scar tissue during the subsequent wound-healing phases.

**Proliferation phase**

The tissue defect is filled with new tissue. Fibroblasts, keratinocytes and endothelial cells replace the inflammatory cells. These cells secrete additional growth factors, which stimulate cell proliferation. The epithelium is re-created by the formation of new epithelium. The deeper parts of the dermis and subcutis are re-created by the formation of granulation tissue. New capillaries are also formed by what is known as angiogenesis. During the proliferation phase, the wound gradually contracts. In terms of time, the proliferation phase can last from some days to weeks.

**Remodelling phase**

The proliferation phase is followed by a re-building phase during which matrix metalloproteases such as collagenase, gelatinase and stromelysin break down the primitive extracellular matrix, during which time the permanent matrix, which is made up of collagen, elastin and proteoglycans, develops.

Human wound healing involves the formation of scar tissue, caused by collagen deposits. In uncomplicated cases, epithelialisation is complete within one to two weeks, but at this point the healing has still not reached its maximum strength and elasticity. This takes place gradually during months and years.

*Authors responsible:* Marie-Louise Ivarsson

**Leg and foot ulcers**

A leg ulcer is not a diagnosis but is instead a symptom of some underlying condition. To enable leg ulcers to heal in the shortest possible time, the correct diagnosis and treatment targeted at the underlying cause(s) are essential.

**The treatment plan includes:**

- treating the underlying cause of the ulcer
• assessing the local ulcer status
• choosing the dressing to match the ulcer diagnosis and current ulcer status
• documenting the diagnosis, ulcer status, treatment plan, choice of dressing and ulcer size (drawing, photo and/or volume measurements)
• checking and following up the diagnosis, investigation and treatment
• preventing new ulcers

Caring for patients with leg and foot ulcers
• All patients with leg and foot ulcers should primarily be assessed by a doctor in order to initiate a treatment plan and implement it in close collaboration with the nurse in attendance.
• The local ulcer status and the patient’s own wishes influences the choice of treatment.
• The medical history should include questions about ulcer duration, previous ulcer treatment, thrombosis, varicose vein operations, leg oedema, medication, allergies (known allergies to medication or externally-applied products), illnesses such as cardiovascular disease and diabetes. A pain history is important.
• Document the size of the ulcer and its location initially and then at regular intervals, such as once a month. The size of the ulcer should be documented using drawings on plastic or measurements of the perpendicular ulcer diameters and/or photographs.
• Document the appearance of the ulcer = local ulcer status.
• Document changes to the skin around ulcers on the foot and leg, as well as any spread of eczema. Make a note of visible oedema.

Types of leg and foot ulcers

Venous ulcers are the most common. The causes of leg ulcers are frequently multifactorial.

• Venous leg ulcers
• Arterial ulcers
• Diabetic ulcers
• Vasculitic ulcers
• Pyoderma gangrenosum
• Necrobiosis lipoidica
• Tumours
• Other leg and foot ulcers

Author responsible: Carita Hansson
Diagnosing leg and foot ulcers

• An investigation of arterial insufficiency should be conducted on all patients with leg and foot ulcers! Many patients with clinically typical venous leg ulcers situated near the medial malleolus have peripheral arterial insufficiency at the same time.

• Only conducting a clinical examination to determine venous insufficiency is unsatisfactory and is associated with a risk of incorrect assessment. An investigation of venous insufficiency with handheld Doppler and in some cases further with colour duplex at the department of clinical physiology is particularly recommended for patients who are candidates for venous surgery.

• An investigation for diabetes with b-glucose/u-glucose/ Hb-A1C is conducted in all patients with ulcers on their feet. Tests are also recommended for all patients with ulcers that are slow-to-heal.

• Other blood and urine tests should be conducted when the condition so indicates.

• Bacterial cultures are not performed as a matter of routine. Fungal cultures should be performed in and around ulcers on suspicion of a mycotic infection; most commonly found is the yeast Candida and more rarely dermatophytes.

• Biopsies can be taken from the edge of an ulcer, if a tumour is suspected and 5 mm outside the edge of the ulcer if a vasculitic ulcer is suspected. Consider taking a biopsy from a venous leg ulcer that has been correctly treated with compression therapy and has not started to heal within six weeks. The biopsy size should be at least a 4 mm punch biopsy (or knife biopsy if possible). The generous use of biopsies is recommended for all ulcers without a definite diagnosis or when the anticipated healing rate is not achieved.

• Biopsies for cultures of mycobacteria (e.g. tuberculosis) or fungus (deep mycosis) from ulcers may be relevant in rare cases.

• If a contact allergy is suspected, a referral should be made to a dermatological clinic for a patch test.

Author responsible: Carita Hansson

Ulcer case record for leg and foot ulcer patients

A leg and foot ulcer case record normally needs to be adapted to match each individual department’s activities.
Patient data
Care giver

ULCER HISTORY
- Ulcer duration
- Previous ulcers

MEDICAL HISTORY
- Cardiovascular disease
- Diabetes
- Neuropathy
- Arthritis
- Stiff ankles
- Smoker
- Previous smoker
- Medication
- Hypersensitivity

Venous disease
- Deep vein thrombosis
- Previously known varicose vein surgery

Peripheral arterial disease
- Known arterial disease, such as intermittent claudication
- Previous arterial surgery or percutaneous transluminal angioplasty

Pain analysis
- Where? When?
- How much? VAS scale
- Use of analgesics – amounts and brands

STATUS
Document
- Make a drawing of the ulcer, measure it with a ruler or take a photograph.

Ulcer appearance
- Red (granular)
- Yellow (fibrin covered)
- Black (necrosis)
- Greyish-lilac (epithelium)
- Green (pseudomonas)

Secretion of fluid
- Amount

Skin changes around the ulcer
• Eczema
• Infection
• Maceration

ASSESSMENTS

• Pulse palpation
• Ankle/brachial blood pressures .../......mm Hg = ABI
• Systolic toe pressures
• Colour Duplex
• Biopsy
• Bacterial culture
• Other examinations

DIAGNOSIS

Referrals

Local treatment
• Dressings/wound treatment products
• Compression therapy

Intervals for dressing changes

Systemic treatments
• Medications

Next visit/check-up doctor

Next visit/check-up nurse

Author responsible: Carita Hansson

Venous leg and foot ulcers

Definition of chronic venous ulcers:”Ulcers below the knee that do not heal within six weeks where venous dysfunction is the most important cause” (Swedish Medical Products Agency 1995; 239-72”Venous leg ulcers”).

Incidence
The prevalence increases sharply with age. More than 50% of chronic leg and foot ulcers are venous. Some 70% of chronic ulcers only located on the lower leg above the ankle are venous.
Pathophysiology
In as many as 50% of patients, venous ulcers can be due to superficial venous insufficiency, while the remainder are caused by deep venous insufficiency or a combination of deep and superficial venous insufficiency. It is not possible to distinguish between deep and superficial venous insufficiency only using clinical examination. If superficial insufficiency is identified following a colour Duplex examination, for example, there is a real chance that this leg ulcer patient can be cured after venous surgery.

Differential diagnoses
All other leg and foot ulcers, such as those caused by arterial insufficiency, vasculitis, pyoderma gangrenosum or cancer should be considered.

Symptoms and signs of disease
• Varicose veins, leg oedema and a feeling of heaviness in the legs are common symptoms of venous insufficiency.
• Pain is most frequently experienced in conjunction with dressing changes, but some venous leg ulcer patients experience severe pain. Keeping the leg in a high position during the night normally alleviates pain in venous leg ulcer patients.
• The venous ulcers are normally located medially on the inside of the lower third of the lower part of the leg.
• The size of the ulcers varies. The surface of the ulcer can be sloughy, but it is seldom covered by black necrotic tissue (see Photo 1).
• Brown pigmentation around the ulcer is caused by hemosiderin, which is iron pigment. The surrounding skin is often dry and scaly and it is sometimes hard (lipodermatosclerosis) (see Photos 2 and 3).
• Venous eczema frequently occurs around the ulcer, as well as on the legs and feet (see Photo 2). Contact allergy eczema is usually more pronounced than venous eczema and spreads outside the dressing applied causing the sensitisation and to other parts of the body.
• “Atrophie blanche” are white scar-like areas with enlarged capillaries, which look like small haemorrhages. The small ulcers that occur here are extremely painful (see Photo 4)
**Photo 1.** Venous ulcer on the medial malleolus. (Photo Carita Hansson)

**Photo 2.** Venous ulcer and eczema and hemosiderin (iron) pigmentation. (Photo Carita Hansson)

**Photo 3.** ‘Lipodermatosclerosis’ with brown pigmented, hard indurated sclerotic tissue ‘piano leg’. (Photo Carita Hansson)
Photo 4. ‘Atrophie blanche’, small ulcers in white scar-like areas with enlarged capillaries. (Photo Carita Hansson)

Examining venous ulcer patients

Medical history
Specific questions to the patient in the event of venous insufficiency:
• Do your legs swell as the day progresses?
• Have you had any deep vein thrombosis?
• Have you undergone surgery for varicose veins?
• Are you sensitive to externally-applied products?

Documentation of ulcers and skin
Make a note of what the ulcer and skin look like and of any eczema spread. Also note visible oedema (measure the calf, if possible).

Author responsible: Carita Hansson

Ankle pressure examination
• An ankle pressure examination to determine arterial insufficiency should be conducted on all leg and foot ulcer patients.
• Please note that, in the event of low ankle pressure, i.e. less than 70-80 mm Hg at the ankle level; compression treatment may impede the healing of ulcers (with the exception of low-stretch bandages).

Examination to determine venous insufficiency
Complete testing to determine venous insufficiency at the department of clinical physiology is only conducted on selected leg ulcer patients. Prior to venous surgery, colour Duplex is a mandatory requirement from vascular surgeons. Many other investigative methods may be used in individual cases.
A clinical examination alone is unsatisfactory and is associated with a risk of incorrect evaluation.

Hand-held Doppler technique used for diagnosing venous insufficiency
An ordinary ultrasound Doppler can be used in an attempt to increase the ability to diagnose a leg ulcer. The purpose is to identify if there is a reflux in the veins in the groin and the knee fold.

Method: The patient should be examined in a standing position. Start listening in the groin area in order to find the artery. The vein is found immediately medially of the artery. While listening to the vein, the examiner’s hand should squeeze the thigh very briefly and the sound of the blood passing the Doppler can then be heard. When the pressure is gone the blood ceases to flow
towards the heart and the signal from the Doppler should then disappear. If a new flow sound is heard instead, this indicates an insufficiency of the venous valves in the groin.

To distinguish between the superficial (vena saphena magna) and deep (vena femoralis) veins is much more difficult and is time consuming. The colour Duplex is superior for this investigation since you can see which vein you are listening to. An investigation with the hand-held Doppler is not so precise and gives a signal from all the flow in the area of its reach.

In the knee fold the same procedure is repeated on the standing patient. Squeeze the calf of the lower leg for a short time, while listening in the knee fold. If the sound of the flow disappears when you release the pressure it points to that the valves are sufficient and this indicates that there is no insufficiency. If there is a sound of blood flowing at the release of the pressure this indicates insufficiency of the valves. Also in this area it is difficult to distinguish between a superficial (vena saphena parva) and a deep insufficiency (vena poplitea) and a colour Duplex investigation is usually motivated.

*Author responsible:* Urban Wingren

**Allergic contact dermatitis**

Patients with venous leg ulcers frequently also have venous eczema (also called hypostatic dermatitis). The venous leg ulcers patients also run a higher risk of developing contact allergies than other ulcer patients.

Venous leg ulcer patients should avoid applying the following directly onto the skin on legs and on leg ulcers:

- Gauze dressings containing lanolin and/or antibiotics
- Perfumed creams and ointments
- Surgical tape/plasters
- Olive oil
- Latex rubber

If a contact dermatitis is suspected, the patient should be referred to the dermatology department for a patch test (epicutaneous patch test).

*Author responsible:* Carita Hansson

**Compression treatment of venous leg ulcers**

Compression treatment is the basis of treatment for venous ulcers and has several effects:

- Venous hypertension is counteracted
- Venous return is improved
- Microcirculation is improved
- Oedema in the tissue is reduced

Compression treatment can be performed in different ways.

- High- or low-elastic (high- or low-stretch) bandages
• Stockings
• Intermittent pneumatic compression

High-stretch bandages and compression stockings are normally taken off in the evening and put back on in the morning.

Compression bandages can be applied as figure eights (see Photo 5) or in circular fashion (see Photos 6a and 6b).

Photo 5. Figure eights with a 50% overlap. (Photo Annika Nordström)

Photo 6a. Circular bandage with a 50% overlap. Nearer bandaging increases the number of turns and the pressure. (Photo Annika Nordström)
**Compression bandaging with elastic (long-stretch) or non-elastic (short-stretch) compression**

**Elastic (long-stretch) bandages** *Elodur fine* or the longer *Perfekta fein* (see Photos 7-9)

Elastic bandages have high working pressure and high resting pressure. The pressure from an elastic bandage should be 40 mm Hg at the ankle, 30 mm Hg at the calf and 20 mm Hg below the knee. The *Elodur fine* and *Perfekta fein* elastic bandage is made of cotton and elastic threads and is 10 cm wide. An elastic bandage is normally taken off at night.

**Photo 6b.** Circular bandage with a 75% overlap. (Photo Annika Nordström)

**Photo 7.** Angle the foot at 90°. Start bandaging from the base of the toe, applying 2 - 3 circular turns and then move up over the heel. (Photo Annika Nordström)
Photo 8. The next turn covers half the preceding one and then continues back down over the foot, effectively locking the turn around the heel. It is important to ensure that the whole heel is covered. (Photo Annika Nordström)

Photo 9. After covering the heel, the bandage should be applied in circular turns with a 50% overlap and 50% stretching of the bandage all the way up to the knee. The bandage should stop 2 cm under the fold in the knee to avoid chafing. (Photo Annika Nordström)

Non-elastic (short-stretch) bandage Pütter (see Photos 10-13)

Choose non-elastic bandages for patients with simultaneous arterial circulation impairment. The Pütter non-elastic bandage is made of cotton and produces a high working pressure and a low resting pressure. In conjunction with compression treatment with non-elastic compression, two bandages are used, one 8 cm wide and the other 10 cm wide.
Photo 10. Start by angling the patient’s foot at 90°. The bandaging begins with an 8 cm wide bandage, starting at the base of the toes, putting the bandage on from the inside (medial side) outwards (to the lateral side). The bandage is applied in a circular fashion for 2-3 turns before continuing up over the heel. (Photo Annika Nordström)

Photo 11. The next turn covers half the previous one and then the bandage goes back down over the foot effectively locking the turn around the heel. It is important to ensure that the whole heel is covered (Photo Annika Nordström)
Photo 12. At the ankle, 3-4 turns with the bandage are applied in a circular fashion, after which one upward turn is applied over the calf. The bandaging is completed with a loose circular turn, 2 cm beneath the knee-fold. (Photo Annika Nordström)

Photo 13. The second bandage is 10 cm wide. Start from the ankle with 8 turns (upwards and then downwards) and a 50% overlap. Finish bandaging 2 cm under the knee-fold. (Photo Annika Nordström)

Stand
Very useful when bandaging legs (Photo14)
Features shared by elastic- and non-elastic bandages

<table>
<thead>
<tr>
<th>Feature</th>
<th>Elastic Bandages</th>
<th>Non-Elastic Bandages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layers</td>
<td>More layers</td>
<td>Produce higher pressure</td>
</tr>
<tr>
<td>Width</td>
<td>Less wide bandage</td>
<td>Produce higher pressure</td>
</tr>
<tr>
<td>Stretch</td>
<td>Higher stretch</td>
<td>Produce higher pressure</td>
</tr>
<tr>
<td>Leg circumference</td>
<td>Smaller circumference</td>
<td>Produce higher pressure</td>
</tr>
</tbody>
</table>

Padding
Padding with Soffban improves the compression effect by levelling the pressure. The padding is applied from the base of the toe to the knee, using circular revolutions of the bandage. Padding can also be used for sensitive or painful areas. Kompresx foam can be cut to size to fill indentations around the malleoli or to take the weight off ulcers.

Maintaining compression
Non-elastic bandages or multilayer compression in the form of double- or four-layer bandages are left on for several days, thereby providing good compression around the clock. Non-elastic bandages are normally replaced at least twice a week, while multilayer bandages are normally changed once or twice a week.

Multilayer compression
A 2 layer bandage Proguide or at double bandage consisting of an inner dressing Zipzoc stocking which is a zinc oxide impregnated medicated stocking and an outer compressive...
A 3 layer bandage Profore lite

The four-layer bandage Profore is available in different sizes, after measuring ankle circumference, and it consists of an ulcer-contact layer, padding layer, layer of crepe bandage, a light compression layer, and a cohesive CoPlus bandage on the outside. It is now also available as latex free.

Seal-Tight
To protect the bandages when taken a shower the Seal-Tight can be used.

Compression product names, size and manufacturers

<table>
<thead>
<tr>
<th>Product</th>
<th>Size</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pütter</td>
<td>8cm x 5m, 10cm x 5m</td>
<td>Hartmann SC</td>
</tr>
<tr>
<td>Coban</td>
<td>10cm x 2,6m</td>
<td>3 M Svenska AB</td>
</tr>
<tr>
<td>Elodur fine</td>
<td>10cm x 7m</td>
<td>Smith &amp; Nephew AB</td>
</tr>
<tr>
<td>Perfekta fein</td>
<td>10cm x 10m</td>
<td>Lohmann &amp; Rauscher AB</td>
</tr>
<tr>
<td>Proguidee</td>
<td>18-22 cm</td>
<td>Smith &amp; Nephew AB</td>
</tr>
<tr>
<td>Profore lite</td>
<td>18-25 cm</td>
<td>Smith &amp; Nephew AB</td>
</tr>
<tr>
<td>Profore</td>
<td>18-25, 25-30, &gt;30cm</td>
<td>Smith &amp; Nephew AB</td>
</tr>
<tr>
<td>Soffban Natural</td>
<td>10cm x 2.5m</td>
<td>Smith &amp; Nephew AB</td>
</tr>
<tr>
<td>Zipzoc ointment stocking</td>
<td>pharmaceutical</td>
<td>Smith &amp; Nephew AB</td>
</tr>
</tbody>
</table>

Compression stockings
Compression stockings, ordered to size, preferably Class 2-3, are primarily used after healing for prophylactic purposes. They need an exact fit and the leg should therefore be measured early in the morning before the leg gets edematous to get the correct size.

Intermittent pneumatic compression with Flowtron Plus HC and Flowpac devices

Intermittent pneumatic compression (IPC) treatment is used for treating leg edema caused by venous insufficiency and/or lymphatic oedema. IPC promotes cyclic emptying and refilling of the veins and lymphatic vessels.

The IPC consists of a double- walled boot, which is filled and emptied, in sequences by an air compressor device. The pressure can be varied in both the Flowtron Plus HC and the Flowpac. The boots are available in three- or one-chamber versions. The three-chamber boot produces a higher pressure distally and a lower pressure higher up, which is a natural pressure gradient.

One leg can be treated individually or both legs can be treated simultaneously.

Flowtron Plus HC is designed for home use and has a fixed compression time and resting time of
30 seconds. *Flowpac* has a pump, which enables the resting, and compression phase to be varied. This is very useful in connection with simultaneous arterial insufficiency, for example. *Flowpac* is used at hospitals and similar institutions.

**Contraindications for using intermittent pneumatic compression therapy**

The contraindications are:
- An untreated oedema as a result of heart failure
- Current skin infection on the leg - erysipelas (cellulitis)
- Acute deep vein thrombosis
- Superficial arterial by-pass
- Pronounced ischemic vascular disease
- Pronounced deformities in the skeleton making treatment impossible.

**Manufacturer**
Huntleigh Healthcare AB. More information [www.huntleigh.se](http://www.huntleigh.se)

**Patient information, self-care and follow-up of venous leg ulcer patients**

- Venous ulcer patients need compression treatment in the form of bandages until the ulcers have healed, followed by compression stockings to prevent recurrences after the ulcers have healed.
- Encourage the patients to keep moving using their muscle pumps and to avoid heavy lifts.
- Instruct the patients to keep the legs in a high position when resting.
- Follow-up after healing is important in order to encourage patients to follow the above advice

*Author responsible:* Carita Hansson

**Vein surgery**

All patients with venous leg ulcers are assessed if they are suited for vein surgery. Colour Duplex investigations are needed to make this assessment and, when the examination has been completed, a surgeon should be consulted.

*Author responsible:* Urban Wingren

**Investigation of arterial insufficiency**

**Pulse palpation**

Try to find the pulses on the dorsum of the feet and behind/below the medial malleoli. If you can palpate a pulse, this normally means that the ankle pressure is good, but an ankle pressure measurement should nonetheless be made. The pulse in the groin on both sides should also be palpated. If the pulse is weaker or if there is no pulse on one side, this indicates that there are narrowings in the artery above the groin.
Also try to palpate the arteria poplitea in the knee-fold (this can, however, be difficult).

Author responsible: Urban Wingren

**Measuring systolic brachial and ankle pressures**

Ankle-brachial index  =  Systolic ankle pressure
                      Systolic brachial pressure

After at least 5 minutes of comfortable resting start the measuring by taking the blood pressure in the arm. To measure ankle pressure, apply the blood-pressure cuff distally on the lower leg (just above the ankles). After palpating the pulse (if possible), some gel should be applied to the area where the ultrasonic Doppler is used to listen to the sound of the flow in the arteria dorsalis pedis (on the dorsum of the foot) (see Photos 15, 16). If you cannot find the pulse, the Doppler should be used in order to find sound of the pulse.

**Photo 15.** Ankle pressure measurement of the arteria dorsalis pedis (Photo: Annika Nordström)

**Photo 16.** Ankle pressure measurement of the arteria dorsalis pedis (Photo: Annika Nordström)
The procedure should then be repeated for the arteria tibialis posterior (behind/below the medial malleolus) (see Photos 17, 18). When the individual arteries have been localised, and a good, clear signal has been obtained, the cuff should be pumped up until the pulsations completely disappear. The pressure should then be slowly released and, when you start hearing the pulsations again, note the value the blood pressure manometer specifies as the ankle pressure. Use the best value (the highest) of the two ankle pressures that are obtained to calculate the index. Use the frequency of 8 MHz for legs of normal size legs and 5 MHz for overweight patients or patients with oedematous legs. The ultrasound Doppler should preferably have loudspeakers.

**Photo 17.** Ankle pressure measurement of the arteria tibialis posterior (Photo: Annika Nordström)

**Photo 18.** Ankle pressure measurement of the arteria tibialis posterior (Photo: Annika Nordström)

In normal circumstances, the pressure at the ankle should be at least as high as the blood pressure in the arm. If the pressure at the ankle is lower, this patient with leg and foot ulcers has some degree of arterial insufficiency.

**Ankle/brachial pressure index (ABI)**

- Normal ABI is around 1 (0.9-1.3)
• **The ABI cannot be evaluated** in the event of a very high index above 1.3-1.4. This means that the ankle pressure is much higher than the brachial pressure. These patients have stiff blood vessels, which can be seen in patients with diabetes and/or hypertension, as well as in the elderly. Patients with high ABI should be further evaluated with a toe pressure examination.

• **Suspect an arterial insufficiency** in patients with an ABI under 0.8 or an ankle pressure of more than 20 mm Hg below the systolic arm pressure.

  N.B. Bandaging can further decrease ulcer healing in patients with peripheral arterial insufficiency, therefore, be more observant when the absolute ankle pressure values are 70-80 mm Hg or below.

• **Suspect that the ulcer is an arterial ulcer** when the absolute ankle pressures is 50 mm Hg below the arm pressure with simultaneous ulcers on the feet.

*Authors responsible:* Carita Hansson, Urban Wingren

### Arterial ulcers

**Definition**
Ulceration or gangrene of the toe or foot and a systolic ankle pressure of <50 mmHg.

**In the case of diabetes**
If the patient has diabetes, the blood vessels may be stiff, making ankle pressure measurements unreliable. In patients with diabetes, systolic toe pressures should be measured and the risk for ischemia is below 30mm Hg.

**Incidence**
For critical ischemia in general with and without ulcers, the incidence has been calculated at 500/million people/year. Diabetics are over-represented in this group. (Information relating specifically to arterial ulcers is largely lacking.)

**Pathophysiology**
Interruptions in the macrocirculation to the ulcer area result in the inadequate supply of oxygen and nutrition, which results in local tissue necrosis.

**Differential diagnoses**
Diabetic ulcers, traumatic wounds, gout-related ulcers, vasculitic ulcers, mixed ulcers – i.e. ulcers
with a different genesis but with arterial features, such as venous ulcers with arterial features.
These ulcers are often very difficult to assess; in other words, how significant is the arterial or
venous insufficiency? Would healing improve after an arterial reconstruction?

**Course**

- In the case of critical ischemia in general with or without ulcers, calculations reveal that some
  60% of patients are treated with vascular surgery, around 20% primarily undergo
  amputation and some 20% receive other forms of treatment (medical). After one
  year, 25% will have undergone amputation, 55% will still have their legs and 20%
  will have died.

- In the case of patients with already established arterial ulcers, the prognosis is said to be poorer
  than the above figures.

- In the case of patients with arterial ulcers and with toe pressures of <20 mm Hg, the prognosis
  for ulcer healing using conservative treatment is very poor.

**Symptoms**

In normal circumstances, the painful, dry ulcers are situated at the peripheral extremities, on the
toes, heels or feet, for example (see Photo 19). The patients suffer from pain during the night
which is alleviated if they hang the foot over the side of the bed. In advanced cases, there is
continuous pain which calls for relatively swift action. In diabetics with neuropathy, the pain can
be less pronounced, in spite of advanced ischemia (see Photo 20 of a diabetic with dry toe
gangrene and Photo 21 of a seriously ischemic diabetic foot).

In so-called combined ulcers, ulcers can also be found at ankle level and on the lower part of the
leg.

*Photo 19. Distal arteriosclerotic gangrene (Photo Jan Holm)*
Photo 20. Diabetic foot. A 65-year-old man has been suffering for many years from diabetes and distal toe gangrene and he has normal, easily-palpable pulses on both the dorsalis pedis and tibialis posterior; in other words, a case of extremely distal diabetic microangiopathy. (Photo Jan Holm)

Photo 21. Diabetic foot. A 69-year-old woman has insulin-treated diabetes and severe ischemia. On the front of the foot, there are pressure-related ulcers and cherry-red toes. The start of wet gangrene can be seen. This patient has palpable pulses in the knee fold, but no pulse peripherally, indicating distal diabetic angiopathy. A case of this kind must be dealt with very swiftly otherwise the gangrene may progress very rapidly. (Photo Jan Holm)

Risk of complications

- Secondary infection with the rapid spread of gangrene
- Sepsis
- Amputation is not really a complication but is instead the result of the progression of existing disease
- Extreme pain
Investigation

Medical history
• Previous diseases
• Medication
• Smoking habits
• Symptoms

Status
• Inspection
• Pulse palpation
• Ankle pressure measurement - and if media sclerosis is suspected:
  The elevation test or toe pressures of the big toe can be used

Referral to vascular surgeon
If the suspicion of an arterial ulcer is confirmed, the patient should be referred to a vascular surgeon.

Continued examination
Prior to vascular reconstruction:
• Colour Duplex (if an iliac obstruction is suspected)
• Pelvic angiography (when the surgical indication is obvious)
• MR angiography is becoming a method more used as a primary investigation as also CT angiography but the traditional angiography is still a leading investigation in many places. One has to contact the local radiology department for information. MR angiography is especially suitable in the event of known hypersensitivity to the contrast used in the traditional angiography. Gau dineum used in MR angiography has been reported with side effects on the kidneys in some cases.

Treatment
• Arterial reconstruction (many variants exist) using either a conventional surgical approach or a minimally invasive method, such as PTA (percutaneous transluminal angioplasty)
• Primary amputation (when vascular reconstruction is not possible and the patient has severe pain or a serious infection)
• Medical treatment (when vascular reconstruction is impossible or contraindicated and the symptoms are of a less serious nature), such as the adjustment of blood pressure, analgesics, ASA (acetylsalicylic acid) and intensive antidiabetic treatment in diabetic patients, and lipid lowering agents in case of hyperlipedemia.

Patient information
• Quitting smoking
• Treatment alternatives
• Risks
Follow-up
After vascular reconstruction: see the surgeon after one month and after one year (minimum) (see Photo 22, which shows a good result). Decisions about the local treatment of ulcers are made in each individual case.

Photo 22. Distal arteriosclerosis after vascular surgery showing that the ulcer is starting to get clean and to granulate. The ulcer healed quickly after a partial-thickness skin graft. (Photo Jan Holm)

Author responsible: Urban Wingren

Ulcers in diabetes

Definition
Diabetes involves a risk of peripheral neuropathy and macroangiopathy. These complications, especially in combination with other risk factors, result in a risk of foot ulcers. In diabetics, they can take the form of different types of ulcer:
• stress ulcers
• interdigital ulcers
• decubitus ulcers
• toe ulcers

Incidence
In Scandinavian studies, the incidence of foot ulcers has been estimated at 3% among diabetics aged 50 and younger and at 8% in diabetics aged 25 and older. In international material, foot ulcers are said to occur in 2-3% of type I diabetics or diabetics aged 50 and younger.

Pathophysiology
The two most important pre-conditions for foot ulcers in diabetics are peripheral neuropathy and
peripheral vascular disease. The sensory and/or motor neuropathy, involve a risk of developing ulcers. The angiopathy can comprise macrovascular atherosclerosis, mediasclerosis or macroangiopathy. There are a number of other risk factors in addition to neuropathy and angiopathy.

**The risk of ulcers increases in connection with**
- smoking
- hypertension
- hyperlipidemia
- obesity
- edema
- neuropathic skeletal illness
- defective metabolic control
- poor understanding of illness
- poor compliance with treatment

**Differential diagnoses**
Venous ulcers, vasculitic ulcers, surgical wounds, tropical wounds

**Course**
Foot ulcers are a major risk factor for new diabetic foot ulcers. Any course is, however, possible when it comes to foot ulcers in diabetics, depending on the patient’s status, including the degree of neuropathy and angiopathy, as well as the location of the ulcer and its size and character.

**Symptoms**
As neuropathy, usually sensory, is one of the pre-conditions for ulcers in diabetics, foot ulcers in these patients are often symptom free. Painful ulcers in diabetics are not unusual, however. The risk of infection in diabetic foot ulcers is immediate, as a result of defects locally and in the general infection defence caused by hyperglycemia and the above-mentioned complications associated with diabetes *(see Photo 23)*.

**Photo 23.** Type II diabetes dating back 15 years in a 60-year-old man with typical ‘Charcot feet’,
Complication risks
• Recurrence of ulcers
• New ulcers
• Failure to heal
• Progressive ulcers
• Sepsis
• Gangrene

Examination
• Medical history
• Status (circulation, oedema, nerve function, skeletal deformity)
• Wound classification (type, localisation, cause, measurement, photography)
• Skeletal examination (X-ray, scintigraphy)
• Circulation examination (toe/ankle pressure, angiography, ultrasound)
• Bacteriological examination
• Metabolic screening
• Pain investigation
• Technical orthopedic investigation

Treatment
• Metabolic control
• Treatment of oedema, pain, impaired circulation and infection
• Removal of possible risk factors, such as smoking
• Reducing the pressure on the ulcer is essential if diabetic ulcers are to heal. This can be achieved using orthopedic engineering measures in the form of supports in shoes and special shoes. In more advanced cases, orthoses or plaster casts can be used (see Photo 24).
• Surgery can be performed prophylactically to rectify different defects that pose a risk in terms of ulcers.
• ASA, blood pressure treatment and lipid lowering agents when necessary

In the case of infection; incision, revision and drainage could save the extremities. Partial or total amputations could save lives in conjunction with infection and/or gangrene.
Photo 24. Fenestrated walking plaster to reduce the load in another type II diabetic, which results in the healing of ulcers. (Photo Bo R Bergman)

Self-care
When it comes to the self-care of diabetic foot ulcers, the most important characteristic is primarily prevention. This can be achieved through screening, as well as regular foot care and training.

Follow-up
Foot ulcers in diabetics involve a risk of new foot ulcers but also of amputation and increased mortality. The character of the ulcer in question governs the follow-up during the treatment of a foot ulcer.

Multidisciplinary care
The primary and secondary prevention of diabetic foot ulcers can only be achieved by fixed routines for foot examinations, self-care training, screening, the elimination of risk factors and optimised metabolic control. The best care for diabetics with foot ulcers can be given by special foot teams with a multidisciplinary composition, as the treatment of these ulcers is based on specialist knowledge in the fields of diabetology, dermatology, vascular surgery, orthopaedics, infectious diseases and orthopaedic engineering.

Author responsible: Björn Eliasson

Foot care for diabetics

Take an interest in your feet!
Wash your feet every day
This will give you a chance to look at and get to know your feet. In a foot bath (once a week), the water should have a temperature of around 36° C (use a bath thermometer). If the water is any warmer, it could damage your skin. Add a mild soap solution or liquid soap to the water. See which feels best. Avoid salt as it dries the skin. Do not have your feet in the water for more than five minutes. Dry your feet carefully with a soft towel – especially between the toes.

Nails
You should cut your nails immediately after a softening bath. Cut them straight and not rounded. Your nails should not be too short. It is a good idea to use nail clippers and a nail file (sandpaper). Make sure that there are no sharp corners pressing into neighbouring toes or into the nail bed.

Callosities (corns)
This is often caused by the skin being subjected to pressure or tear. Hard skin should be filed down when dry. You can use a foot file covered in sandpaper. Beware of more powerful “graters”. You should never cut or remove hard skin yourself and never use strong preparations such as corn treatments or other softening products.

Taking care of dry feet
This requires the right amount of moisture. A chiropodist or pharmacy can advise you about a good softening cream or oil. Apply this kind of product to your feet every day. Avoid getting it between your toes – this area should be kept dry. Rub all the cream/oil into the skin. Avoid applying it to ulcers.

Socks/stockings
They should fit snugly, be made of cotton or wool and have no seams or hard elastic. If there are seams, turn the socks inside out. Make sure no folds occur in the socks, as this could cause chafing. Change your socks/stockings every day. If you have impaired sensitivity, you should avoid walking barefoot.

Shoes
Your shoes should not fit too tightly, but this does not mean that they should be loose. Use leather shoes or gymnastic shoes with a wide fit, a large toe cap, a snugly-fitting heel and a rigid sole. Take care with uneven seams, torn lining and other uneven areas. Make a habit of emptying your shoes before you put them on. If your sensitivity is impaired, you may not feel that there is something in your shoe which could chafe and damage your foot.

Cold feet
The best way to warm cold feet is to put on another pair of socks, preferably made of wool. A heated pad/hot-water bottle or hot baths should be avoided as burns may occur if you have impaired sensitivity.

Look at your feet
You should look at your feet every day and check the skin, especially between the toes. Look for cracks, red areas and wounds. A mirror is useful when you inspect the soles of your feet.
Smoking
Smoking should always be avoided as it has negative effects on the circulation.

Remember
At the slightest indication of a wound or irritation – contact us at the centre for diabetes care or your chiropodist. Make sure you have your feet checked when you visit the doctor.

Did you know that most foot ulcers are caused by pressure from shoes?

Author responsible: Tordh Tierfeldt

Vasculitic ulcers

Necrotising vasculitis – allergic vasculitis

Definition
Skin reactions that occur because of an inflammation in the blood vessels in the skin, usually immunological genesis.

Incidence
They can occur at all ages. Patients with rheumatic diseases are over-represented.

Pathophysiology
Antigen-antibody complex or cytotoxic cells are deposited in the vascular wall and cause inflammation and differing degrees of tissue damage (necrosis). Sometimes, pharmaceutical antigens, virus antigens or bacterial antigens cause vasculitic ulcers. On some occasions, a vascular injury can be the cause of an autoimmune vascular inflammation (vasculitis).

Differential diagnoses
Other leg and foot ulcers, such as those caused by venous or arterial insufficiency, pyoderma gangrenosum, cancer or infection.

Symptoms and signs of illness
There is often an acute debut bilaterally on the lower part of the leg, sometimes more widespread on to the thighs, arms and other places. The skin lesions are characterised by “palpable purpura”, small, raised inflammatory hemorrhages in the skin. A spectrum of different skin lesions is frequently seen in the same patient, both purpura and palpable purpura, blister formation and ulcers (see Photos 25 and 26).
Allergic vasculitis may occur simultaneously in other organs, usually the kidneys (N.B. look for haematuria), and in the gastro-intestinal tract (can cause gastric pain).
Examination and investigation
- Clinical signs and biopsy
- Underlying infection? Hepatitis? Streptococci? Borrelia?
- Malignancy?
- Drugs?
- Rheumatic disease?
- Allergic vasculitis in other organs? Haematuria? Blood in faeces?

Treatment
The basic cause of the ulcers is primarily treated. Any medication suspected to cause the vasculitic reaction is discontinued. If there are progressive symptoms, a great deal of pain or signs of renal involvement, steroids are given.

Authors responsible: Karin Rosén, Eva Bagge

Vasculitis ulcers – vasculitis in connection with autoimmune disease
In about one-third of the cases, vasculitis is associated with some form of autoimmune disease.
Vasculitis is not synonymous with ulcers, but it can lead to the development of ulcers.

Vasculitis in connection with rheumatoid arthritis
Vasculitis in connection with rheumatoid arthritis primarily affects patients with a long-term aggressive disease, more frequently in men than in women. These patients often have no clinical signs of an increase in disease activity, such as swollen joints, but they may have extra-articular signs of disease, such as rheumatic noduli, pleurisy or pericarditis, serious eye symptoms (episcleritis) and general symptoms in the form of tiredness, a general feeling of being unwell, weight loss and so on. The patient often has anaemia and a high erythrocyte sedimentation rate, high rheuma factor titres and low complement levels.

Other autoimmune diseases
• Systemic lupus erythematosus (SLE)
• Sjögren’s syndrome
• Systemic vasculitis (periarteritis nodosa, Wegener’s granulomatosis, allergic granulomatosis – Churg Strauss)

The definition of rheumatic (autoimmune) vasculitic ulcers is: Painful ulcers that defy all attempts at local treatment in patients who usually have long-term rheumatic disease.

Pathophysiology
Autoimmune mechanisms. The acute injury to the vascular wall is mediated by immunocomplexes; immunocomplex and complement are found in the affected vessels. At an early stage, inflammation and necrosis are seen in the vascular wall. Connective tissue infiltration and obstruction in blood vessels are seen at a later stage.

Differential diagnoses
All other leg and foot ulcers may be considered.

Symptoms and signs of illness
There is often an acute ulcer debut (usually several) on the lower leg or the dorsum of the foot. The ulcers are normally painful and punched out with an indurated base (see Photo 27).

Photo 27. Rheumatoid arthritis and ulcers. (Photo Karin Rosén)
Examination and investigation

- Clinical signs
- Laboratory tests – erythrocyte sedimentation rate, CRP (C-reactive protein), white cell count, platelets, urine dipsticks, antibody profile, circulating immunocomplex, complement factors
- Toe and ankle pressures
- Biopsies are taken at least 5 mm outside the edge of the ulcer

Treatment

If there is a clinical suspicion of necrotising vasculitis and/or a biopsy to support the diagnosis, treatment with immunosuppression in the form of peroral steroids and cytotoxic drugs should be initiated.

- Peroral steroids
- Cyclophosphamide (Sendoxan) in an infusion (pulse treatment every three to four weeks)
- Cyclosporine (Sandimmune Neoral) has been tested in combination with pinch-graft

Authors responsible: Karin Rosén, Eva Bagge

Pyoderma gangrenosum

Definition

Special type of chronic ulcer with an undermined inflammatory edge.

Incidence

Unusual. Over-represented among patients with inflammatory intestinal diseases, rheumatoid arthritis, acute leukaemia, paraproteinemia.

Pathophysiology

The cause of this severe skin inflammation is unknown sometimes it starts after trauma and sometimes occurs spontaneously.

Differential diagnoses:
Vasculitic ulcers, ulcers in conjunction with infection, ulcers caused by arterial insufficiency.

Symptoms and signs of illness

Relatively acute debut of one or more ulcers. Clinically typical appearance with reddish-blue surroundings, undermined edges and a honeycomb-like ulcer bed (see Photo 28).

- The usual localisation is the lower leg, but these ulcers can also occur in other places.
- They sometimes follow trauma, such as a surgical wound.
- Often painful ulcers.
Examination and investigation
- Clinical diagnosis – exclude other causes using biopsy and ankle pressure.
- Medical history: inflammatory intestinal disease? Rheumatic disease? Other symptoms?
- Investigation: routine tests including differential white blood count, lung X-ray, ANA, Rheumatoid factor, protein electrophoresis.

Treatment
- Treatment of the underlying disease
- If the ulcers are small, treatment with intralesionally or topically applied steroids can be tested
- Systemic treatment with steroids and/or salazopyrin
- Cyclosporine (Sandimmune Neoral)

Author responsible: Karin Rosén

Necrobiosis lipoidica

Definition
Special skin inflammation localised on the front sides of the lower legs. Ulcers that have difficulty healing may occur. Necrobiosis lipoidica is most common in patients with diabetes.

Symptoms and signs of illness
Red, clearly demarcated patches with central atrophy and teleangiectasia. Sometimes there is ulceration (see Photo 29).
**Photo 29.** Necrobiosis lipoidica on the front sides of the lower legs of a young woman with diabetes. (Photo Karin Rosén)

*Author responsible:* Karin Rosén

## Tumours – cancer ulcers

**Definition**
Ulcers can occur in skin tumours, but skin cancer can also make its debut in the form of ulcers. Histological examination for diagnosis.

**Incidence**
Basalioma – basal cell carcinoma is the most common tumour. Squamous cell carcinoma, melanoma and other skin tumours are less common.

**Symptoms and signs of illness**
Ulcers that will not heal. Often atypical ulcer localisation (see Photo 30).

**Photo 30.** An 82-year-old woman with basal cell carcinoma (Photo Karin Rosén)
**Pressure sores (decubitus)**

**Definition**
Pressure sores (decubitus) occur when the skin has been subjected to ischemia because of pressure, either from the patient’s own body or from external objects. If an ulcer of this kind does not heal within six months, it is known as a chronic ulcer.

**Incidence**
Decubitus affects unconscious patients in intensive care, patients with spinal cord injuries who have lost motor and sensory function and in the elderly. Within geriatric care, the prevalence is 10%, while it is 10-15% in nursing homes. Decubitus in the sacral region, of the ischial tuberosities and on the heels, is most common – in other words, surfaces that are exposed to a load when lying and sitting without any reduction of the load.

**Pathophysiology**
Pressure on the tissues above bony prominences causes ischemia in the skin. Mechanical effects such as tension and shear also cause damage to tissues. Moisture caused by incontinence, for example, increases the risk of decubitus ulcers.

**Differential diagnoses**
Ulcers with another genesis

**Risk factors**
Factors that produce an increased risk of decubitus ulcers are:

- age
- unconsciousness
- shock – heart failure
- pareses
- sensory loss
- peripheral vascular disease
- inactivity
- malnutrition
- fever
- severe depression

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**Diagnosis**
Biopsy at the edge of the ulcer involving both the ulcer and healthy skin, at least 4 mm punch biopsy or knife biopsy.

**Treatment**
Surgical excision

*Author responsible:* Karin Rosén
• cachexia (weight loss)
• cancer
• faeces incontinence
• urine incontinence
• low blood pressure
• dehydration
• anaemia

**Diagnosis of decubitus ulcers**
About 80% of all decubitus ulcers are located on the heels, sacrum, ischial tuberosities and trochanter prominences (see Photos 31-34). These areas should be regularly inspected in patients with one or more risk factors. The treatment of established decubitus ulcers should begin with an assessment of the patient and the ulcer. The assessment of the patient is designed to identify the factors that are important in terms of the occurrence of ulcers.

**Staging**
Clinical classification based on the tissue that is damaged and the ulcer involvement.
• Stage 1 Permanent red patch that does not become any paler (see Photo 31).
• Stage 2 Damage to the epidermis, such as a blister (see Photo 32).
• Stage 3 Damage to the dermis and/or subcutis (see Photo 33).
• Stage 4 Damage to underlying tissue deeper than the subcutis, such as bone, tendons, musculature (see Photo 34).

**Photo 31.** Decubitus Stage 1 Permanent red patch that does not become any paler (Photo Christer Traneroth)
Photo 32. Decubitus Stage 2 Damage to the epidermis, such as a blister (Photo Christer Traneroth)

Photo 33. Decubitus Stage 3 Damage to the dermis and/or subcutis (Photo Christer Traneroth)

Photo 34. Decubitus Stage 4 Damage to underlying tissue deeper than the subcutis, such as bone, tendons, musculature (Photo Christer Traneroth)

Symptoms and signs of illness
Patients with no sensory loss complain of pain in the sacral area, the hips and heels. In patients
with spinal cord injuries, a decubitus ulcer can sometimes cause autonomic dysreflexia with a pronounced increase in blood pressure, sweating and shivering. Pressure on the skin produces red patches that are the early stages of decubitus ulcers.

**Examination**

Inspection of common ulcer locations:
- sacrum
- heels
- trochanter areas
- ischial tuberosities

**Investigation**

Laboratory diagnosis: hemoglobin, erythrocyte sedimentation rate, CRP (C-reactive protein), albumin in serum and blood glucose. Patients with large decubitus ulcers sometimes obtain laboratory values that raise a suspicion of malignant disease. If the ulcers display signs of infection, such as an unpleasant smell, pus and/or reddening and an increase in heat in surrounding areas, a bacterial culture should be taken from the ulcer and antibiotics should be administered to match the resistance pattern of the culture.

**Treatment**

- Relieve the pressure using the right mattress. The load must be completely removed if the ulcer is to heal. The patient should not be positioned on his/her ulcer. In difficult cases, a Clinitrone bed should be used.
- Underlying illnesses must be diagnosed.
- Good nutrition
- In the event of extensive decubitus ulcers in patients who can be operated on, pedicle flap surgery should be considered.

**Prevention**

Decubitus ulcers can be avoided if the patients are turned at regular intervals, their skin is checked and, if signs of incipient decubitus ulcers are seen, the load is removed from the area. In the event of fractures to the vertebral column and injuries to the spinal cord, log-rolling can be used. This means that, every three hours, the patient is turned on his/her side, the skin is inspected and washed and the patient is then returned to lying on his/her back.

Training is very important for both the prevention and care of established decubitus ulcers. This kind of training must be given to both health-care staff and patients. It increases people’s awareness of the risks and problems and has been shown to reduce the risk of ulcer development and increase the frequency of healing.

*Author responsible:* Christer Traneroth

**Ulcers in spinal cord injured patients**

The loss of the ability to move and the loss of sensory function in connection with spinal cord injuries and diseases of the spinal cord lead to a major risk of developing ulcers. Decubitus ulcers
occur when the pressure on the skin is not reduced at regular intervals. Burns occur because the injured person does not feel that objects that come into contact with the skin below the injury level are hot. Shear ulcers develop when people with spinal cord injuries sit and slide around in bed. Moreover, the risk of ulcers increases because of the pronounced change in the autonomic nervous system’s control of inner organs. Patients with spinal cord injuries run a life-lasting increased risk of developing ulcers. The loss of important warning signals imposes major requirements on individual responsibility.

**Incidence**
Decubitus ulcers may occur all over the body, but they are primarily seen in areas exposed to pressure, such as the sitting areas, the heels, the back of the head, the shoulders, the malleoli and the sacrum. Burns usually occur in the knee, as patients with spinal cord injuries transport hot things while sitting in their wheelchairs. Shear ulcers occur on the sacrum and upper sitting areas.

**Pathophysiology**
The loss of sensory function results in the loss of an important protective mechanism. In addition, patients with spinal cord injuries are subject to a change in body composition, as muscles are replaced by adipose tissue. Heat regulation is due to the inability of sweating and of constriction of the blood vessels in the cold below the level of the injury. In addition, when the skin is subjected to pressure, the oxygen tension in the skin is lower in patients with spinal cord injuries. Some data indicate that the collagen turnover changes in patients with spinal cord injuries and that this further increases the risk of skin damage.

**Risk factors**
In addition to the risk factors that are shared with other groups of patients, the following specific risk factors can also be identified.
- Total loss of sensory and motor functions below the level of the injury
- Change in temperature regulation below the level of the injury, with the inability to sweat in the heat and the inability of the microcirculation to constrict in the cold
- Loss of important control mechanisms in the blood circulation below the level of the injury
- Low activity level
- Physical constitution:
  - Overweight
  - Underweight
- Impaired ability to take responsibility for one’s body:
  - Other illnesses, somatic, physical
  - Drug or alcohol abuse

**Prevention**
Preventive measures are absolutely vital. Preventive work is a task for the whole treatment team around the patient. To avoid decubitus ulcers, patients with spinal cord injuries should be turned at regular intervals. If the patient has recently been injured and has an unstable fracture, he/she should be turned using the log-rolling procedure every three hours. Three to four people turn the patient on his/her side, the skin is inspected and washed and the patient is then returned to lie on his/her back.
So-called U cushions should be used under the calves to remove the load from the heels while lying and the health-care staff should make sure that the sole of the foot does not push against the foot of the bed. A patient with spinal cord injuries should never sit up in bed, as there is then a major risk of shear injuries. Wheelchairs and cushions should be tested to provide a good sitting position and to reduce the pressure. Nutrition treatment is important as both overweight and underweight are risk factors. The treatment of urine and faeces incontinence is very important when it comes to avoiding ulcers.

Patients with spinal cord injuries should then be given ongoing training in preventive action this includes techniques for a good sitting position in wheelchairs, techniques for unloading the pressure and techniques for turning in bed. The clothing and shoes should be checked in order not to cause pressure. The patients shall make an inspection of the skin using a mirror. Patients should be trained in instructing the health-care staff and personal assistants about the effects of spinal cord injuries.

**Investigation**

Since ulcers can be avoided, it is very important to find out why they occur. Sitting positions, lying positions, cushions and mattresses should be examined. If the patient has recently been injured or is seriously ill, the routines for taking care of him/her should be reviewed and this is the responsibility of the health-care staff. If the patient has had his/her injury for a long time and an ulcer suddenly occurs, this is an indication that, for some reason, the patient has been unable to take responsibility for his/her damaged body. This may be due to another serious disease, mental illness, depression or focusing on other tasks. The patient’s mental and physical status should therefore be evaluated.

**Treatment**

When decubitus ulcers occur, the load should be totally removed from the area subjected to pressure. Treatment with hydrogels, foam dressings and VAC (vacuum assisted closure) are often effective. The surrounding skin should be protected. There is negative experience when it comes to the use of thick hydrocolloid dressings on decubitus ulcers in patients with spinal cord injuries. This could be due to the fact that the dressings were not combined with a reduction in load.

If the decubitus ulcer is large, plastic surgery may sometimes be required. Pre-operatively, any ulcer infection or osteomyelitis must be treated. The bladder and intestine regimen should be optimised, other illnesses should be treated and the nutrition should be reviewed. In the same way, the patient’s ability to co-operate must be evaluated. Pre-operatively, dead tissue should be removed from the ulcer. VAC treatment and a Clinitrone bed are often valuable. Post-operatively, the patient should be treated using a Clinitrone bed, followed by a pressure-reducing mattress in order to be mobilised gradually to a sitting position. To avoid new ulcers is very important.

Nowadays, many decubitus ulcers are treated at the out-patient spinal cord injuries clinic. The patient comes to the clinic once a week and is examined by a LPN with responsibility for ulcers and, whenever necessary, by a doctor. One important part of the investigation involves analysing why the ulcers have occurred and taking suitable action, such as adjusting wheelchairs, changing mattresses and treating other illnesses. The ulcers should then be revised and the patient should be instructed in the future care of the ulcers. Treatment takes place in collaboration with the
Pressure sores (decubitus) prophylaxis – a working model

Within institutional geriatric care, many patients are in the risk zone when it comes to developing decubitus ulcers. Avoiding these ulcers reduces suffering for the patient, shortens treatment times and also saves money in the longer term.

Every patient is assessed
At the geriatric ward, Sahlgrenska University Hospital/ Sahlgrenska, every patient who is hospitalised is assessed for the risk of developing decubitus ulcers. To assist us, we use the modified Norton scale with a maximum score of 28 points.

Patients usually come to us in the afternoon. A diet registration is performed during the first complete day. This means that a risk assessment is made on the morning of the third day, preferably by a nurse and an LPN (licensed practical nurse) in collaboration. The personnel use the clinic’s memo on pressure sores to assist them. It contains practical instructions on performing the medical records. This memo can be accessed on the website for staff working at Sahlgrenska University Hospital on the intranet area geriatrics.

Diagnosis, giving report on patients, and patient arrival talks usually leads to taking preventive actions before the Norton assessment is complete. The patient’s skin is assessed when he/she arrives. The nurse responsible for his or her patient also makes notes of any pressure sore in the medical record. The staging of the ulcers is assessed on the Shea scale from 1-4.

Nurses in charge of skin changes and ulcers
Each ward has a nurse and LPN in charge of skin and ulcers. We have a record on our intranet where the LPN makes a note of the number of patients who have been assessed and how many of them are at risk. The LPN also makes a note of how many patients had an ulcer on arrival and how many developed an ulcer while they were in the ward. A special note is made of the number of risk patients who developed a pressure sore. The number of healed ulcers is also followed up.

We have started to calculate the amount of resources that are required to treat pressure sores, measuring the time changing dressings.
It is our strategy to ensure that no pressure sore develop on any patient.

Beds
We make the beds somewhat differently for risk patients (see Photo 35). The beds may not look
as tidy without a blanket, but we put as little as possible between the patient and the mattress.

To identify the patients who are risk patients, we put a small red label on the end of the bed.

It is important that the diet registration functions and that the risk assessment is made quickly to prevent pressure sores in the patients in whom no action has as yet been taken.

Photo 35. Marja Kensfors LPN to the left and Florence Åhsberg LPN to the right

Strategic skin/ulcer group
The clinic’s strategic skin/ulcer group is responsible for determining how the preventive work functions. This is an interdisciplinary group comprising doctors, nurses, physiotherapists and occupational therapists. We meet the manufacturers of wound dressings and mattresses. A large number of preventive mattresses have been purchased. We test and evaluate suitable material.

Modified Norton scale
On the modified Norton scale, the seven parameters below are assessed. Each variable has a point scale from 1 - 4. If the total score is 20, the patient is regarded as a risk patient.


Author responsible: Jan Wendeby

Burns

Definition
A burn injury is the tissue damage caused by high temperature. Burns also include injuries as a result of electricity, chemical substances, frost-bite and radiation.

Incidence
About 25,000 burns are annually treated as out-patients in Sweden. Approximately 1,500 of them are admitted to hospitals. Mostly scalds, while adults more often suffer from fire accidents, much
more frequently injure children.

**Symptoms and clinical course**

A *superficial burn* is characterised by erythema and pain. Such a burn heals within a week without leaving any residual scar.

A *superficial dermal burn* involves the epidermis and superficial parts of the dermis. Blisters, erythema and severe pain are observed *(see Photo 36).* The wound will heal in two or three weeks. It will heal with minimal scarring and pigmentation alterations.

A *deep dermal burn* is more serious. The injury penetrates deep into the dermis and is characterised by erythema without capillary return, less pain and a humid surface lacking blisters *(see Photo 37).* Healing occurs in three to six weeks with dense scarring.

A *supdermal burn* (full-thickness burn) involves all skin elements and sometimes also the underlying tissue. The burn is often painless, as pain nerve endings have been destroyed. The burn may be white, yellow, brown or black in colour. The skin is leathery and hard *(see Photo 38).* These burns cannot heal from underneath, instead the skin must be excised and replaced, with the exception of small burn areas.

*Photo 36.* Superficial dermal burn (Photo Lars Caldenby)
Treatment
The wound care aims at maintaining a moist and clean environment to enable the best possible healing. During the first days after the injury, there is often extensive exudate. Dressings that do not adhere to the wound surface improve healing and make exchange less painful. Bacteria always contaminate burns, but antibiotics are not used prophylactically. A wound culture should always precede the prescription of antibiotics. Silver dressings may be considered. Wounds after burns that have just healed are sensitive to even slight traumas for a long period and a moisturizing cream should be applied to them.

Surgical treatment
Surgical treatment is used for deep dermal and subdermal burns to obtain a good functional and aesthetic outcome. Non-viable tissue is excised and the area is then covered using a split-
thickness skin graft. Sometimes a full-thickness skin graft or a skin flap may be used to ensure an uneventful healing and a good aesthetic or functional coverage of the area.

**Treatment of large burns**

Large burns, deep burns and a specialist should handle more severe burns in sensitive areas such as the face, hands, feet and anogenital areas. Burns that involve a large part of the surface of the body require intensive care and are treated at special burns units in Linköping, Malmö, Stockholm or Uppsala.

All the severe burns in the region can be treated in consultation with the Clinic of Plastic Surgery at Sahlgrenska University Hospital (adults) or the Pediatric Surgery Clinic at the Queen Silvia’s Children’s Hospital (children).

**Rehabilitation**

Physiotherapy and occupation therapy are included in the treatment of many burns. When difficult scarring is anticipated, compression clothing is used on affected areas during one to two years after the burn.

*Author responsible:* Peter Tarnow

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**Lymphedema**

**Definition**

A lymphedema is caused by the lacking capacity of transportation in the lymphatic system and can be caused by diseases, birth defects, trauma in the soft tissues or previously given treatments.

The flow of fluid back into the blood vessels occurs in 90% to the veins and in 10% to the lymphatics. The lymphatic system has an ability to increase its transportation capacity when there is an enhanced requirement, for example when an activity increases the pulse beat, which also increases the outflow to the tissue. There is an increased need of transportation via the lymphatics for example in venous insufficiency and in states with increased production of fluid, as in an infection. If the need continues for a prolonged time, there is an exhaustion of the lymphatic transportation and an edema occurs.

Edema can be a problem for wound healing. If customary compression treatment does not decrease the edema it is usually of value to consult a specially trained lymphtherapeut who decides if increased treatment may decrease the edema.

In order to find out whether an edema exists or not the following should be done:

**History**

- Is there edema in the family, in your parents or other relatives?
- Has the patient experienced a larger soft tissue trauma in the area of the ulcer or centrally?
Has the patient been operated on with the removal of the lymph nodes?
Has the patient had any type of malignant tumour?

Examination
Perform a palpation around the ulcer and centrally towards the flow away directed from the ulcer. Compare with the healthy side.
Skinfold test should be experienced in the same way on a comparable side of the body without ulcer. Make a skin fold of the epidermis between the thumb and the index finger at the same time and compare.
Pitting test shows if the tissue is filled with fluid. Press as hard as possible against the tissue during 60 seconds and a remaining indentation in the skin shows a positive test.

Treatment
Compression with short stretch elastic bandages and/or compression stockings daytime or during the whole day and night is the basic treatment for lymphedema.
If the compression does not give the result expected the patient should be referred to a physiotherapist with special knowledge in lymphedema.

Prevention
Patients with known risk factors should be provided with compression bandages as a preventive measure and be controlled at a regular basis.

Ansvarig: Kerstin Björfjäll

Handling fistulas

Overview
A fistula is a connection between an inner organ and the surface of the skin or between two inner (cavity) organs. This summary only deals with fistulas between the intestines and the abdominal wall, enterocutaneous fistulas. Fistulas in the rectal area also fall outside the framework of this summary.

Enterocutaneous fistulas

Incidence mechanisms
An enterocutaneous fistula occurs as a result of a disease process that breaks down the intestinal wall or as a result of the leakage of intestinal contents due to an intestinal anastomosis that fails to heal normally. Postoperative, enterocutaneous fistulas, which occur after intestinal surgery and begin in an intestine that has undergone surgery, normally occur in patients that have some serious general disease, as cancer or Crohn’s disease. Nowadays, spontaneous fistulas almost always only occur in connection with Crohn’s disease, but they can sometimes be seen in conjunction with advanced cancer.
**Initial treatment**
When spontaneous fistulas occur, this seldom affects the patient’s general condition and specific action in the acute stage is rarely required. Treatment with antibiotics is, for example, seldom necessary.

Fistulas that occur during the postoperative period, on the other hand, develop in patients who are affected by both the illness that caused the operation, the surgical trauma per se and the severe inflammatory reaction (peritonitis), which is the first sign of leakage from an intestinal anastomosis. For this reason, the initial treatment must focus on general supportive treatment with blood, plasma, fluid, electrolytes, energy, antibiotics, and so on. The effective drainage of the intra-abdominal accumulation of intestinal contents is important. It is often necessary to remove skin sutures and perhaps individual sutures from the fascia.

**Continuing care**
Once the acute situation has been dealt with, the target for the treatment is to create the best possible conditions for healing. This means that the patient must be generally in the best possible condition and that the area of the fistula should be well bandaged. To improve the patient’s general condition, he/she often requires parenteral nutritional treatment, combined with possible antibiotic treatment and so on. Local treatment around the fistula is designed to collect fistular secretion as effectively as possible and to prevent the skin being exposed more than necessary to fistular secretion. A bandage of this kind is normally created using different kinds of colostomy bandage or special fistular dressings (“wound dressings”). One important objective is to keep secretion from the fistula to a minimum, as excessive fistular flow leads to difficulty bandaging, fluid and electrolyte disorders and difficulty getting the patient into the anabolic phase. Peroral nutrition often impedes this process and must therefore be reduced to keep the flow as low as possible.

**Nutrition and enterocutaneous fistulas**
In the past, there was some enthusiasm for enteral nutrition in general and astronaut nutrition in particular in connection with enterocutaneous fistulas. Detailed clinical studies are, however, unable to demonstrate any primary healing effect from these dietary regimens. Different forms of nutritional solutions have not been shown to be any more effective than normal food. It is, on the other hand, decisive that the patient is given sufficient amounts of food. The limiting factor when it comes to peroral or enteral nutrition is the fistular flow, see above. If the fistular flow can be kept below 200-400 ml/day with peroral supply, this is acceptable.

**Pharmaceuticals and enterocutaneous fistulas**
There is nothing to prove that medicines are primarily able to cure fistulas. Using Sandostatin analogues, it is possible to reduce the secretion from a fistula and thereby improve the conditions for healing. In connection with fistulas due to Crohn’s disease, the inflammatory features can be reduced in some cases with immunomodulating treatment (azathioprine, infliximab). There are no studies that demonstrate that these pharmaceuticals produce permanent healing.

**Continued course of enterocutaneous fistulas**
Acute surgical action in connection with postoperative enterocutaneous fistulas should be taken with the greatest caution. Performing straightforward raphy at fistular openings or
supplementing leaking anastomoses with new sutures are directly contraindicated and lead without fail to new leakage. A well-positioned colostomy orally around a fistular area in the intestine, with the aim of reducing the load, can, however, have a positive effect. Surgical action should be avoided for around three months to create an opportunity for granulation, to enable the patient to get over the anabolic phase and, at best, provide an opportunity for spontaneous healing.

**Healing enterocutaneous fistulas**

Fistulas that develop from the lower part of the small intestine and the large intestine generally heal with conservative treatment within a period of three months. Fistulas from the oral (proximal) part of the small intestine and fistulas with a high flow or where the distal flow from the fistular area is not satisfactory have little chance of healing and, in such cases, surgical reconstruction is required. An operation of this kind should not be performed for at least three months.

**Summary**

In the acute phase; save the patient, avoid surgery. In connection with conservative treatment: reduce the flow and nourish the patient. In the longer term: wait for spontaneous healing before performing active surgery.

*Author responsible:* Svante Nordgren

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**Stomas and skin problems**

**Definition**

The word stoma comes from the Greek language and means mouth. In the medical terminology the term stoma is an artificial opening between two organs. In the area of abdominal surgery the term stoma means a surgically constructed opening in the intestines, where the intestine is brought out through a circular opening in the abdominal wall. The intestinal end is everted (wrought in and out) and sutured to the skin.

**Prevalence**

Stoma operations are performed on people in all ages. The causes are for example, a congenital deformity, anal atresia, inflammatory intestinal diseases, diverticulitis, trauma, radiation damages, intestinal ischemia, ano-rectal incontinence, injury sustained in childbirth, fistulas or cancer.

The current total number of stoma-operated persons in Sweden is about 20 000.

**Stoma types**

The name of the stoma type is given due to the operative localisation in the intestine. A stoma may be single-barrelled or double-barrelled, permanent or temporary, depending on the cause of the operation.
**Ileostomy**
The most common indications are inflammatory intestinal diseases (ulc.colitis and Crohn’s colitis) and familial polyposis.
The construction is performed by first incising the skin in a preoperatively marked location. The distal end of the small intestine is brought out through a circular opening in the abdominal wall. The intestine is everted and a 2-3 cm long ileostomy is constructed.

**Loop-ileostomy**
The indications for this double barrelled temporary stomas are to protect an anastomosis after colorectal surgery or as a relief in order to heal a fistula.

**Kolostomy/sigmoideostomy**
The indications are colo-rectal cancer, diverticulitis, radiation enteritis, and injuries.
The construction is performed by first incising the skin in a preoperatively marked location. The sigmoidal intestine is brought out about 3-4cm through a circular opening in the abdominal wall. The intestine is then everted and an 1 – 2 cm high stoma is constructed.

**Urostomy**
The indications are urinary bladder cancer, interstitial cystitis, bladder fistula, neurogenic bladder dysfunction mm.
An isolated segment of the distal small bowel is used for construction of an urostomy. The ureters are implanted in the intestine, which serves as a conduit for evacuation of the urine.

**Preventing skin damage**
The skin around the stoma should be treated with great caution to avoid traumatizing the skin. The stoma appliance has to be removed carefully, using a moistened compress. The skin is cleaned with soft moistened compresses with lukewarm tap water. Soap and cleansers, which dry out the skin, should be avoided. The skin is dried with a soft compress. Abundant hair growth around the stoma should be removed at a regular basis. The hair should be shaved in the same direction as the hair grows on a dry skin.
The bandage is attached to clean and dry skin. The hole in the flange of the appliance should be tightly applied close to the stoma.

**Skin problems**
Skin problems around the stoma are common. One study reports a frequency of 73 % (C Lyon 2001).

**Contact dermatitis, (not allergic) irritative** (toxic irritable dermatitis) (see picture stoma 39) is caused by chemical, toxic or mechanical damage to the skin. Urinary or faecal leakage is the most common cause.
The treatment varies depending on the cause. A common cause is that there is a too large hole in the stoma flange. When there are severe skin damage or leakage problems, the stoma therapist should be contacted.
Skin infections with bacteria and yeasts (see Picture stoma 40) occur around the stoma if the skin is damaged. The treatment should be performed by a stoma therapist and/or a physician.

Allergic contact dermatitis is seldom caused by the material used for stomas today. When allergic contact dermatitis is suspected a dermatologist should be consulted.

Granulomas, small “wart”like growths (see Picture stoma 41). These delicate, red, regularly bleeding growths start at the edge between the stoma and the skin and may grow to a size of several centimetres in diameter. Histologically these growths are granulation tissue. If the
granulomas cause bleeding or other symptoms the treatment is coagulation with silver nitrate or cryotherapy or even laser therapy
A stoma therapist should perform the treatment.

Picture stoma 41. Granulomas, small "wart"like growths (Photo: Jeanette Fingren).

**Folliculitis** is an inflammation in the hair bulb and the loose hair is easily pulled out at bandage change. When the skin around the stoma is shaven carelessly there will be a direct connection down in the hair bulb for staphylococci or streptococci. Folliculitis appears as dotted redness and sometimes pustules or vesicles and may cause itching and pain.
Treatment; an abundance of hair is treated carefully with shaving. The stoma therapist should be contacted if the folliculitis causes pain or itching.

Among the **skin diseases** atopic dermatitis and psoriasis may cause problems in managing stoma care. In patients with inflammatory bowel disease **pyoderma gangrenosum ulcers** (see Photo stomi 42) may develop.
Therapy; skin diseases should always be treated by the stoma therapist together with a physician.
Thorax surgery wounds - mediastinitis

Definition
Microbiologically-established deep wound infection in the mediastinum or infection in the sternum with or without sternum insufficiency (see Photo 43).

Pathophysiology
In some 70%, Staphylococcus aureus or coagulase negative staphylococci are isolated. In 40%, cultures produce a mixed infection. Gram-negative bacteria or fungi are very unusual.

Risk factors
Overweight, diabetes mellitus, chronic obstructive pulmonary disease.

Incidence
The incidence varies between 0.4-5% of all patients undergoing cardiac surgery. At Sahlgrenska University Hospital, the incidence is about 1.5%. Mediastinitis usually starts 2-6 weeks after the primary operation.

Differential diagnosis
Superficial subcutaneous infection in the wound. Sternum insufficiency without infection.

Symptoms
Sometimes there are no classical signs of infection.
- Temperature > 38°C after postoperative day 2
- High CRP and an increase in the white blood count
- Pain
• Wound rupture (occurs in 70% of cases)
• Sternum insufficiency
• Slow postoperative mobilisation

Photo 43. Thorax surgery wound (Photo Henrik Scherstén)

Investigation
• Inspection of the wound area
• Palpation of the sternum (snapping)
• Bacterial culture from the wound if possible
• X-ray or CT-scan of the sternum, looking for osteitis
• Contact the thorax department for swift transfer of the patient

Treatment
Antibiotic treatment based on the resistance pattern, normally an infusion of Vancomycin. Surgical treatment with mechanical cleansing, stabilisation of the sternum and the insertion of disinfection drainage. VAC (vacuum assisted closure) treatment may be an option. In serious cases, it is not possible to stabilise the sternum and the wound has to undergo secondary healing, involving the formation of a fibrous plate, after which plastic surgery can be performed at a later date.

Author responsible: Henrik Scherstén

Evaluation of bacterial findings in a culture from a wound

The value of a culture is largely dependent on the way the sample is taken. In ideal circumstances, a pure culture of the bacterium that is causing the infection can be obtained. Both the person taking the sample and the bacteriologist must understand and be familiar with the terms infection, colonisation and contamination.
**Infection, colonisation and contamination**

Every wound is moist, warm and full of nutrients for bacteria. Therefore, bacterial growth always starts a short time after wounding.

**Colonisation**
Colonisation takes place when there is a profuse growth of bacteria in the wound without any signs of infection.

**Infection**
An infection has probably developed if the patient has redness, swelling, pain or unusually profuse secretion from the wound. The inflammatory reaction is due to the fact that bacteria invade as yet undamaged tissue around the wound, breaking down tissue with their enzymes and toxins.

In cultures from both infected and colonised wounds, profuse growth is usually obtained, as the bacteria in both cases are established and constantly multiplying.

**Contamination**
Contamination of a wound usually occurs from the surrounding skin, or from body orifices like the mouth or anus or from the patient’s environment. In connection with contamination, the culture findings are normally sparse and are also composed of several different species. If the wound environment is suitable for any of these bacteria, they can establish themselves and start to grow – colonise – and, in the worst case-scenario, become invasive and cause infection.

**Taking samples**
Samples should only be taken when there is an infection that is planned to be treated with antibiotics. In order to be able to correct any antibiotic treatment already initiated, the bacteria are cultured and their resistance is determined. If a sample is taken directly from a sloughy wound, the bacteria causing infections and those colonising and contaminating bacteria will all be cultured. Sometimes growth of this kind can in fact conceal the bacteria causing the infection. Cultures of this kind are useless and perhaps even misleading. Prior to sampling, the wound must therefore be carefully cleaned to remove colonising bacteria and contaminants. Samples should then be taken against or in the infected tissue where the bacteria causing the infection are located, to enable culturing and determination of resistance.

Skin-colonising bacteria are coagulase negative staphylococci, diphtheroids, Propionibacterium sp., as well as mycobacteria, fungi and anaerobic streptococci. *Staphylococcus aureus*, which is a common cause of wound infection, is also part of the skin flora in some 40% of the healthy population.

The respiratory flora around the nose and mouth and the intestinal bacteria on the genitals and legs also contaminates the skin. Skin-colonising bacteria and contaminating intestinal bacteria can cause wound infections, especially in patients with impaired general health.

**Prevent the spread of infection**
Basic hygiene routines is the most important procedure when it comes to preventing the spread of
bacteria within health-care work, such as taking samples and dressing wounds. These routines should be applied in all health-care activities and examination situations by staff of all kinds.

**Basic hygiene routines involve:**
- Hand disinfection prior to clean work and after sloughy work!
- Disposable plastic aprons if there is a risk of splashing when dressing wounds!
- Gloves should be used in contact with body fluids and secretions

By using basic hygiene routines at all times the spread of infection is avoided.

**Oclusive dressings**
The more dressing changes, the more risk for the spread of disease. For this reason, occlusive dressings are recommended whenever possible. These dressings are often designed to be left for several days, thereby dramatically reducing the number of opportunities for the spread of infection.

*Authors responsible:* Christina Åhren and Eva Skyman

**Infected wounds**

**Definition**
An infected ulcer displays signs of inflammation as a result of bacterial invasion in the tissue, with redness, swelling, increased heat, pain and increased secretion. This secretion can be serous, purulent and sometimes smell unpleasant.

**Incidence**
All types of ulcers can become infected – venous, arterial, diabetic, vasculitic and decubitus ulcers, postoperative wounds, traumatic wounds.

**Pathophysiology**
The risk of infection in an ulcer increases when the circumstances for healing are less favourable, in connection with the occurrence of edema, necrotic tissue, foreign material, arterial insufficiency or diabetes. Bacteria and the toxic products they produce cause local inflammation and sometimes also fever and general symptoms. A wound can be a starting point of a septic infection in which the bacteria get into the circulation and produce severe, even life-threatening symptoms. In connection with traumatic wounds, the tissue is devitalised with bleeding (hematoma), which promotes bacterial growth, but the general defence against infection may also be impaired.

**Etiology**
The cause of infections in superficial wounds is usually staphylococci (*S. aureus*) and/or streptococci (hemolytic streptococci group A, but also group C or G).
The cause of deep wound infections can also be staphylococci and/or streptococci, but a mixed flora of gram-negative bacteria such as *E.coli*, Pseudomonas and anaerobic bacteria is often also involved.
Unusual bacteria such as *Clostridium tetani* (tetanus) and *Clostridium perfringens* (gas gangrene) can cause life-threatening infections.

**Symptoms**
Wound infections can be superficial or deep. In connection with superficial infections, the patient is not generally affected and normally does not have any fever. In connection with deeper infections, generalised symptoms, fever and sometimes sepsis can be seen. Deep infections in soft tissues and/or in the skeleton can produce abscesses, gangrene and necrotising fasciitis and tendovaginitis, in diabetics, for example. (see Photos 44-47)

**Photo 44.** Cellulitis/erysipelas with blisters and a secondary ulcer (Photo archives of the department of infectious diseases through Marie Studahl)

**Photo 45.** Pseudomonas infection in a venous ulcer (Photo archives of the department of infectious diseases through Marie Studahl)
Photograph 46. Cellulitis / flegmone (diffuse infection between the skin and the fascia of the muscles – the type of bacteria unknown (Photo archives of the department of infectious diseases through Marie Studahl)

Photograph 47. Gangrene of the foot after surgical revision. (Photo archives of the department of infectious diseases through Marie Studahl)

**Complication risks**
Recurrences of wounds, new wounds, failure to heal, progressive wounds, sepsis, gangrene.

**Examination**
Questions to determine the depth of the infection:
- Signs of abscess?
- Surgical revision?

**Investigation**
Wound culture for bacteria. After careful mechanical cleansing of the surface of the wound, a sample should be taken with a culture stick. N.B. Do not take a culture from pus since pus primarily contains leukocytes and cytotoxic products created to kill bacteria. Superficial cultures from wounds correspond to only 20% of the bacteria that can be found deep in the wound. Deep tissue biopsies should therefore be the aim in connection with deeper infections, aspiration cultures from abscesses and bone biopsies if there is a suspicion of osteomyelitis. Blood cultures should be performed if the patient is generally affected and has a fever.
Treatment
In patients with a high temperature who are generally affected or in connection with extensive local infection, systemic antibiotics are best given parenterally. On a daily basis consideration should be given to change to peroral treatment. Peroral treatment is administered in cases with mild infections and patients who do not have fever.

Antibiotic treatment for superficial wound infections
In connection with superficial wound infections caused by staphylococci and/or streptococci, penicillin preparations are the first-line choice. For peroral treatment, penicillinase-stable penicillin should be chosen – isoxazolyl penicillin (Heracillin). It is initially preferable to use a higher dose and then 500mg- 750 mg x 3. The second-line choice is clindamycin (Dalacin) 150-300 mg x 3 perorally or, alternatively, Cefadroxil 500mg-1g x 2. Avoid broad-spectrum antibiotics whenever possible, as they easily produce resistant bacteria strains.

Antibiotic treatment for deep wound infections
In connection with deep wound infections (abscesses) and wet gangrene with signs of infection, combination treatment with broad-spectrum antibiotics and anaerobic preparations (metronidazol, Elyzol) may be suitable. In connection with chronic osteitis and the formation of fistulas, long-term antibiotic treatment based on the resistance pattern should be administered.

It is a good idea to consult a specialist in infectious diseases!

Pseudomonas infection
Peroral ciprofloxacin (Ciproxin) should only be administered in connection with clinical infections involving pseudomonas in short courses of 10-14 days at doses of 500 mg x 2 (reduce the dose in elderly patients aged more than 70 years of age and in conjunction with impaired renal function). Do not administer ciprofloxacin if there is only colonisation. This preparation has a poor effect on Staphylococcus aureus. Pseudomonas and S. aureus very rapidly develop resistance to ciprofloxacin.

Author responsible: Marie Studahl

Pain

Multidisciplinary pain centre

www.paincenter.se

Author responsible: Peter Dahm

Local treatment of wounds
You should always aim for:

- Painless, quick, cost-effective healing
- Protection from infection between patients and patient-staff-patient
- Few interested staff members changing the dressings
- Few dressing changes where the type of dressing and the frequency suit the healing phase of the ulcer. More frequent changes are chosen for exudating, infected, malodorous and sloughy wounds. The frequency of dressing changes should be reduced to a minimum in a clean healing wound
- Few types of dressings well familiar to the staff
- Avoiding topical wound preparations with known risks for developing resistance or sensitisation reactions, as for example topical antibiotics
- A moist environment for the wounds except in cases with wound infection (exposure to the air may be indicated if wounds are infected with pseudomonas, for example)

*Author responsible:* Carita Hansson

**Local ulcer status**

**Necrotic** dead tissue is hard or loose in yellow, brown or black. The most common yellow tissue in the ulcer is slough largely made up of dead tissue, fibrin, serum fluid, dead cells and white blood cells.

**Fibrin deposits (see Photo 48)** or slough, when deposits are loose they may easily be wiped away. Tendons can also be seen in the ulcer bed, in the form of yellowish-white fibrotic more woody tissue.

![Photo 48. Sloughy yellow, fibrin-covered, malodorous venous ulcer (Photo Carita Hansson)](image)

**Black necrosis** is a sign of dead tissue in arterial insufficiency (see photo 19), especially in conjunction with gangrene, but it can also be seen in parts of an ulcer after an infection.

**Granulation tissue (see photo 49)** contains new blood vessels and is bright red in colour, with buds that can easily bleed. Sometimes there is too much granulation, 'hypergranulosis', 'proud flesh'. The hypergranulated tissue can be treated by changing to a more airy dressing type – for example a paraffine gauze dressing, or by applying topical steroids or silver nitrate solution
(lapis).  (see photo 50)

Photo 49. Clean ulcer with granulation tissue. (Foto Carita Hansson)

Photo 50. Hypergranulation tissue ‘proud flesh’. (Foto Carita Hansson)

Epithelium consists of new cells greyish-lilac in colour. (see Photo 51)
**Photo 51.** Islands of new epithelium in venous leg ulcer. (Foto Carita Hansson)

A green colour can be seen in wounds or on dressings if there are a large number of pseudomonas bacteria (see Photo 45)

*Author responsible:* Carita Hansson

**Skin changes around wounds**

To reduce the risk of maceration and the development of new wounds, the skin close to exudating wounds can be protected by applying zinc ointment, zinc Vaseline, zinc paste, normal Vaseline or a skin-barrier film around the edges of the ulcer. *Natusan zinc ointment* is a product without lanolin and perfume. *Cavilon No Sting* is a skin-barrier film that maintains its effect for several days. In most cases, absorbent wound dressings reduce secretion from wounds. Edema treatment reduces the fluid produced by wounds and the maceration of the edges of the wound.

*General skin care in patient with ulcers*

Skin care is important in order to prevent new wounds from occurring. Dry skin easily cracks and can be the site of infection. Dry skin produces itching, which can lead to eczema. When the patient scratches himself/herself, infection can also occur.

The skin dries out as a result of exaggerated washing with soap. Mild soap with a low pH value is preferable.
The regular application of moisturising agents is recommended. Perfumed products should be avoided. Pharmacies have a wide range of these products.

**Eczema**

Whenever possible, avoid sensitising substances in the treatment of ulcer patients (particularly in the case of venous leg ulcer patients), such as lanolin, local antibiotics and perfume, as well as garlic and olive oil. In the event of eczema, treatment with cortisone cream or ointment is required. Refer the patient to the dermatology department for a patch test if contact dermatitis is suspected.
Candida albicans
A moist environment increases the possibility of yeasts growing Candida albicans is the most common species. Candida infections seen in the armpits, the groins or other skinfolds may also be found around wounds of different types. The clinical symptoms are redness, pustules, and even purpura. Treatment with fungicidal preparations like Pevaryl or Lamisil cream is used. When there also are signs of eczema one of the following creams can be chosen Cortimyk or Pevisone.

Author responsible: Carita Hansson

Debridement and cleansing of wounds

Wounds are as a rule washed with lukewarm tap water – using clean routines. Sterile sodium chloride solution is avoided because of the high cost and is used in exceptional cases, for wounds that penetrate deep into tissue expected to be sterile, such as inner organs, the skeleton, and the joints. Sterile solutions are also recommended when the drinking water is not controlled.

Autolytic debridement
The autolytic debridement of fibrin and necroses is the way wounds clean themselves, by using a moist environment. The majority of modern dressings aid in achieving such an environment.

Mechanical debridement
Mechanical debridement is performed with scissors and tweezers, curettes and knives. It is always important to perform mechanical cleansing with special caution and stop the procedure when healthy tissue is reached (bleeding). It is especially important to be careful in patients with diabetes and/or arterial insufficiency, and decisions if the procedure should be performed has to be decided in each individual case.

Anaesthesia
Mechanical debridement is often painful, and topical anaesthetic cream/gel/ointment/solution should be used whenever necessary. This includes lidocaine (Xylocaine) or lidocaine/prilocaine cream (EMLA). A maximum of 10 grams of EMLA cream may be used for open wounds at each dressing change prior to mechanical cleansing.

Author responsible: Carita Hansson

Larva therapy –debridement with maggots

Since 1997, the dermatology clinic at SU/S has been using larvae to debride necrotic ulcers and on infected ulcers. This treatment was initially evaluated within the framework of an FOU - project in the Västra Götaland Region and it is now part of everyday clinical routine, even within out-patient care. The larvae are bred under microbiological control at the dermatology clinic.
laboratory. They are distributed at cost price, even to other clinics and health-care institutions not only in Sweden but also in the other Nordic countries.

The species of fly (*Lucilia Sericata*) that is used for ulcer treatment is common in the Nordic countries, Europe and the USA. The reason why this particular species is used is that it is easy to breed in clean conditions, that it lays a large number of eggs, which are also easy to clean, and that it lives on dead tissue and leaves healthy tissue alone.

To use larva therapy of ulcers is easy, but it calls for special dressing-change routines to protect the edges of ulcers and the surrounding skin from proteolytic enzymes and increased ulcer secretion. The change of dressing must also enable the larvae to receive oxygen and a suitable supply of moisture, in order to prevent them from suffocating, drowning or dehydrating.

**Larva application and removal**

1. The ulcer should be cleaned in the normal way with lukewarm water, so that any residues from used ulcer products are removed.

2. The ulcer should then be drawn on double folded "plastic film" using Indian ink. The plastic that has been in contact with the ulcer should be thrown away.

3. The drawing of the ulcer should be transferred to a Duoderm standard hydrocolloid dressing and the central parts of the hydrocolloid plate (corresponding to the ulcer cavity) should be cut out. This gives you a dressing that covers the edges of the ulcer (see Photo 52).

![Photo 52. The ulcer is drawn and the template is transferred to the Duoderm dressing. (Photo Carita Hansson)](image)

4. The larvae are then applied to the ulcer. This can either be done by removing the clean larvae from the transport bottle using a cotton- tipped applicator (see Photo 53) or by "rinsing" out a few larvae onto a net using sterile sodium chloride solution. These larvae are usually 1-2 mm in size when they are applied to the ulcer – in other words, they are relatively newly hatched. It may be difficult to estimate exactly how many larvae that are put into the ulcer, but 5-10 larvae per cm² of ulcer area are a suitable number to aim for.
5. When the larvae have been applied to the ulcer, an "escape-proof" net, such as Tegapore (3M), is fixed to the Duoderm dressing (see Photo 54). The waterproof Sleek tape (Smith & Nephew) is suitable for this purpose (see Photo 55).

Photo 53. The larvae are carefully applied to the ulcer. (Photo Carita Hansson)

Photo 54. Escape-proof Tegapore net is applied on top of the dressing. (Photo Carita Hansson)

Photo 55. The net is fixed in place using Sleek tape. (Photo Carita Hansson)
Photo 56. An airy outer dressing is fixed loosely in place. (Photo Carita Hansson)

Photo 57. After one to three days, the dressing and the larvae are removed. (Photo Carita Hansson)

Remember:
• Do not attach the tape to the skin! On top of the net, fluffy gauze compresses are applied. They can be moistened with sterile sodium chloride solution on the first day of treatment if the ulcer is dry. The compresses are fixed in place with large gauze bandages (see Photo 56).
• Refrain from compression treatment while larva therapy is being used. Otherwise there is a risk that the larvae will be suffocated or squashed.
• Once or twice a day, the fluffy compresses should be replaced. The wound secretion usually increases during the second day of treatment and it is therefore a good idea to change to dry compresses after the first day.
• During dressing changes, the larvae receive a little extra oxygen (exposure to air through the Tegapore net).

When the larvae reach their maximum size of about 1 cm, they should be removed from the ulcer. This normally happens after 3 days, but they can sometimes be fully grown after just 1-2 days.
The whole dressing including the larvae should then be removed (see Photo 57). The larvae can easily be flushed down the sink using a hand-shower, picked out with tweezers or picked up/wiped off with a compress.

The larvae only need to be treated as "hazardous waste" if the larvae treatment has been used on an ulcer with MRSA, or on a patient with hepatitis or other such infections.

Patients do not normally experience any discomfort in connection with this treatment. Some patients may experience a reduction in pain, while others may sometimes find that the pain increases. In the latter case, patients usually manage to complete the treatment if the pain-killing medication they are already receiving is increased at the same time. Otherwise the larvae are removed.

Orders
Sterile larvas can be ordered via the Department of Dermatology at Sahlgrenska University Hospital/Sahlgrenska, 413 45 Gothenburg, Sweden, phone +46 31 3422749 or mail: maggotts.su@vregion.se
The larvae will then be sent by post to the person ordering them. One consignment comprises a sterile bottle containing 250 larvae, which are sufficient for an ulcer area of 25-50 cm², plus patient information and user’s instructions with illustrations.

Author responsible: Carita Hansson

VAC (Vacuum-assisted closure)

Vacuum-assisted closure (VAC) is a method used in order to increase wound healing. The method was developed for about 10 years ago in the USA and has since 1995 been a commercially available product. The method has spread during the last 3-4 years the method has been introduced in Sweden to a smaller extent in public health care.

Knowledge about how the method works is based on a few animal (pig) studies and on a few clinical studies performed in a scientifical way. During the last years a large amount of clinical reports have been shown with positive experiences of the method but still there is a lack of larger scientifical clinical studies. At the department of plastic surgery SU/Sahlgrenska the method has been used to increase wound healing in different situations but also as an aid in healing partial and full skin grafts.

In pig studies the method has been shown to
- Increase growth of granulation tissue in a wound
- Increase local blood flow in the vicinity of a wound
- Decrease the interstitial edema close to a wound
- Decrease the amount of bacteria in a wound
In brief, the method includes using a polyurethane or polyvinyl alcohol foam in the wound which then is covered by a semi-occlusive bandage, and through a suction tube applied to a vacuum pump a suction pressure of 125 mm Hg is applied (in painful wounds starting on 50 mm HG). This pressure is kept during days to weeks depending on the indication for the treatment. The foam bandages are usually changed each third day. Down below is an example of how the VAC with bandages can look like.

![Photo 58, 59. A wound without and with the VAC bandage applied. (Photo Håkan Hallberg)](image)

The equipment for VAC is found in one appearance for in-patients in hospitals (Photo 60) and another for outpatients (Photo 61). The manufacturer educates the health care personnel on demand at the place where the VAC is going to be used.

![Photo 60 Stationary VAC, and Photo 61 Portable VAC (Photo Håkan Hallberg)](image)

Manufacturer: KCI Clinical AB. www.kci-medical.com

Author responsible: Håkan Hallberg
Skin transplantation – pinch or punch grafts

Skin grafts speed up the healing process and reduces the pain from the ulcer. Transplants can be used on all superficial ulcer types. The exceptions are cancer ulcers, actively inflamed vasculitic ulcers and infected ulcers. The ulcer should be clean and granulated, with no signs of infection. The straightforward pinch- or punch-graft method is used for small ulcers, while a meshed, partial-thickness transplantation is recommended for large ulcers (refer to the plastic surgeon).

Under local anaesthetic, 3-5 mm superficial pieces of skin are normally taken from the thigh. In conjunction with a pinch graft, the pinched skin is cut off, while, in a punch graft (see Photo 62), the skin is picked up using a rounded biopsy knife and cut off. The pieces of skin are placed on the ulcer with several millimetres in between and are covered with a non-adhesive dressing, such as Jelonet, Atrauman, Lomatuell-H vaseline gauze dressings or Mepitel silicone dressing. The inner dressing should not be changed over the next few days, usually not for a week. The outer dressing should be inspected every day, if possible, and changed if necessary. The patient should rest for the first few days after the transplantation with the leg elevated to avoid the formation of oedema. Compression treatment is recommended.

Photo 62. Punchgrafts in an ulcer (Foto Annika Nordström)

Author responsible: Carita Hansson

Ulcer products

Ulcer products should be:
• harmless and non-toxic
• non-damaging to the surrounding skin or the ulcer
• non-allergenic
• protect newly-formed epithelial cells and vessels (granulation tissue)
• pleasant for the patient to use
• be easy to change
• non-odourous

**Ulcer environment**

A number of ulcer products help to produce a suitable ulcer environment. The right level of humidity, temperature and pH is needed to give the ulcer the best conditions for healing. Moist ulcer healing promotes epithelial growth. The temperature in the ulcer should be uniform and around 32°C. Ulcer dressings should therefore not be changed more frequently than necessary, as the temperature is reduced when dressings are changed. It takes about 40 minutes to return to the same temperatures as before the dressing change. It is known that occlusive ulcer products produce good temperature control.

Exposing the ulcer to air not only cools the ulcer but also dries out the environment. In some cases, ulcers are left in the air in order to reduce the number of bacteria since most bacteria do not survive being dehydrated.

**Remember to** use tepid tap water when cleaning the ulcer. Wounds normally have a pH value of between 7.3 and 8.9 (mean value 7.7).

**Choose ulcer products on the basis of:**

1. the underlying cause of the ulcer
2. local ulcer status (e.g. exudation, necroses)
3. pain – some ulcer products provide more pain-relief than others
4. social factors, such as the patient’s desire to treat his/her ulcer him/herself
5. economic factors

**1. Underlying cause of the ulcer**

The underlying cause of the ulcer should be the primary point of focus. In the case of venous ulcers, compression bandaging is an effective treatment.

**2. Local wound status**

If the ulcer is exudating, use absorbing wound products like the alginates or hydrofibre dressings. In the event of fibrin and/or loose necroses use debriding wound products like the gel products. In conjunction with dry wounds or wounds producing moderate amounts of secretion, passive, protective ulcer products are often used.

**Sloughy, fibrin-covered wounds with infection:**

In the case of a sloughy, fibrin-covered ulcer where infection is suspected, a silver dressing may be considered (*Acticoat, Actisorb Plus 25, Aquacel Ag, Contreet*) or cadexomer iodine (*Iodosorb*), or *Sorbact* can be used. If a clinical infection in the area of the ulcer is suspected, systemic (not local) antibiotics should also be administered.
Malodourous ulcers or wounds with an unpleasant smell:
Actisorb Plus 25 and Carboflex are ulcer dressings that contain carbon and counteract unpleasant
smells. Carboflex is used for wounds that produce more secretion.

Sloughy, fibrin-covered exudating wounds:
Iodosorb cadexomer iodine, Aquacel hydrofibre and Suprasorb A alginate dressings absorb
wound secretion, cleanse sloughy wounds and form gel. Iodosorb should not be used for deep
ulcer cavities. Aquacel and Suprasorb A have fillers (tamponade) for deeper wounds. Ligasano is
ideal for cleansing running, sloughy and necrotic decubitus ulcer cavities.

Sloughy, fibrin-covered, drier, less exudating wounds:
A moist environment usually removes fibrin and necrotic tissue from wounds. Hydrogels produce
a moist environment, Suprasorb G gel contain sodium carboxymethyl cellulose, which
contributes still further to dissolving the fibrin. The gels require a secondary dressing such as Pro
sårđyna to prevent them drying out. The hydrocolloid dressings Duoderm and Comfeel plus
contains carboxymethyl cellulose which create a gel that also removes fibrin. Hydrogels and
hydrocolloid dressings are most suitable when the ulcer does not have excessive exudation.
Polyurethane-foam dressings retain the moisture in the ulcer. The level of absorbent ability
varies. Allevyn Standard and Mepilex should be used for wounds that secrete mildly or
moderately.

Exudating, clean deep wounds:
In conjunction with exudating, clean, deep wounds, Allevyn Plus Cavity, Aquacel, Ligasano or
Suprasorb A can be used.

Exudating, sloughy wounds:
Ligasano is suitable for cleansing exudating, sloughy ulcer cavities, for example in decubitus.
The Ligasano tamponade/filler can also be used to keep fistula ducts open.

3. Pain
Dressings that produce gel normally provide the best pain relief and this is thought to be due to
the protection of sensory nerve endings. Fewer dressing changes also result in pain relief and
whenever possible fewer dressing changes are preferable.

In the case of painful wounds with little secretion, Pro sårđyna, Jelonet, Atrauman, Mepilex or
Mepitel dressings may help to relieve the pain. In the case of painful wounds covered with fibrin
and or necrosis, preparations in gel form, such as the Suprasorb G gel or the Duoderm and
Comfeel plus hydrocolloid dressings, may relieve pain. In the case of exudating, painful wounds,
the alginate Suprasorb A dressing or the Aquacel hydrofibre dressing may relieve pain.

Polyurethane-foam dressings also help to relieve pain. Allevyn Standard is suitable for clean,
heavily- to moderately-secreting wounds, while Allevyn Cavity is suitable for clean, exudating,
deep ulcer cavities, while Mepilex is suitable for more superficial types of wounds, especially
those with sensitive skin. Polymem for more superficial and PolyMax for deeper ulcers can be
used.

Iodosorb cadexomer iodine compresses also form a gel, but patients may experience initial
burning after application. Local anaesthetic gel in the form of *Xylocaine* can be used under *Iodosorb* compresses, whenever necessary.

**4 and 5. Social and economic factors**

Some ulcer products are regarded as more cost effective than others. The cost is primarily dependent on the number of dressing changes that are needed and an effort should be made to change dressings as infrequently as possible. It is, however, extremely important that dressings are changed sufficiently often when an ulcer is heavily exuding or sloughy.

If the patient so wishes and is able to change his/her own dressings, the cost comprises the cost of material for dressing changes. The rules governing when patients can be given wound products and other materials and when they must purchase them themselves are currently showing a discrepancy, an issue which patients and their relatives in PASS are working with.

*Author responsible:* Carita Hansson

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**Links to websites relating to wounds and wound therapy**

Wound Healing Society Göteborg Bohus website:  http://www.sahlgrenska.se/sggb

The latest news in diabetes  
http://www.diabetolognytt.com/aterkommande/storgoteborgsktvardprogram.html

Danish association for ulcer care  http://www.saar.dk

Strategy group for the rational use of antibiotics and reduced resistance to antibiotics:  
http://www.strama.org

Örebro Ulcer Care Book:  http://svbok.orebroll.se

Swedish Wound Healing Society  http://www.sarlakning.com

International Biotherapy Society IBS: http://biotherapy.md.huji.ac.il

Swedish Oedema Association:  http://www.lymfan.nu/

Further information about wound-healing products and a product catalogue can be obtained from WESTMA  http://wwwhot.vgregion.se/westma/

*Author responsible: * Carita Hansson
Companies that produce the above-mentioned wound products and items used in wound therapy

Abigo Medical AB
Datavägen 29
SE-436 32 Askim, Sweden
www.abigo.com

Coloplast AB
Box 10171
SE-434 22 Kungsbacka, Sweden
www.coloast.se

Convatec, Bristol Myers Squibb AB
Box 15200
SE-167 15 Bromma, Sweden
www.convatec.com

HARTMANN-ScandiCare AB
Box 24, Depågatan 2
SE-334 21 Anderstorps, Sweden
www.hartmann.se

Huntleigh Healthcare AB
Box 30012
SE-20061 Limhamn, Sweden
http://www.huntleigh.se

Johnson & Johnson AB
Staffans väg 2
SE-191 84 Sollentuna, Sweden
http://www.jnj.se

KCI Clinical AB
Pyramidvägen 7, plan 3
S-169 56 Solna, Sweden
Tel + 46 31 7067678
http://www.kci1.com/products/vac

Lohmann & Rauscher AB
Authors responsible for the text and photos on this website: addresses and fax numbers

Eva Bagge, MD, Department of Rheumatology SU/M
Fax +46 31 3432498

Bo R. Bergman, MD, Department of Orthopaedics SU/Ö
Fax +46 31 3434092

Kerstin Björfjäll, physiotherapist, Department HPRAS, SU/Ö
Fax +46 31 3434469

Peter Dahm, MD, Department of Anesthesiology (Centre of Pain), SU/S

Björn Eliasson, MD, Department of Medicine (Centre of Diabetes care) SU/S
Fax +46 31-823820

Jeanette Fingren, SRN, Department of Surgery, Colorectal unit, SU/S
Fax 031-413892
Håkan Hallberg MD, Department of Plastic Surgery, SU/S
Fax +46 31-342 1209

Carita Hansson, MD, Department of Dermatology SU/S
Fax +46 31 821871

Marie-Louise Ivarsson, MD, Department of Surgery and Orthopedic Surgery, Kungsbacka
Fax +46 300 565415

Ann-Katrin Karlsson, MD, Institute of Clinical Neurosciences, Spinal Unit, ward 12, SU/S
Fax +46 31 415835

Svante Nordgren, MD, Department of Surgery, Colorectal unit, SU/S
Fax +46 31 413892

Karin Rosén, MD, Department of Dermatology SU/M
Fax +46 31 3432062

Henrik Scherstén, MD, Department of Surgery, Thoracic clinic SU/S,
Fax +46 31 417991

Eva Skyman, SRN, Department of Bacteriology, Infection hygiene SU/S
Fax +46 31 3424901

Peter Tarnow, MD, Department of Plastic Surgery, SU/S
Fax +46 31-3421209

Marie Studahl, MD, Department of Infectious diseases, SU/Ö
Fax +46 31 847813

Maritha Telander, LPN, Department of Geriatrics, Spinal cord injuries clinic, SU/M
Fax +46 31 416719

Tordh Tierfeldt, LPN, Podiatrist, Department of Medicine (Centre of Diabetes care) SU/S
Fax +46 31 823820

Christer Traneroth, MD, Department of Geriatrics, SU/Ö

Jan Wendeby, SRN, Department of Geriatrics, SU/S
Fax +46 31 205795

Urban Wingren MD, Department of Vascular Surgery, SU/S

Christina Ähren, MD, Infektionshygien, SU/S,
Fax 031-342 4901

SU = Sahlgrenska University Hospital
S = Sahlgrenska, SE-413 45 Göteborg, Sweden telephone switchboard +46 31 3421000
Ö = Östra, SE-416 85 Göteborg, Sweden
M = Mölndal, SE-431 80 Mölndal, Sweden