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MEDIZIN & PRAXIS *Spezial*

– Disturbances of Wound Healing –

Removal of wound bacteria from infected and colonized wounds with Cutisorb® Sorbact®

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Removal of wound bacteria from infected and colonized wounds with Cutisorb® Sorbact®

Every wound, even an aseptic surgical wound, is contaminated with microorganisms. However, this does not necessarily mean that the wound is infected. Only when bacteria penetrate deeper into the wound, multiply, damage the tissue with their toxins or induce symptoms of inflammation can we speak of an infection. Widely used methods of infection control include systemic antibiotic therapy and local antiseptics with a variety of agents capable of acting on the cell structure of pathogenic organisms, but also the body's own cells.
Cutisorb® Sorbact® ***wound dressings work without a chemically active agent and therefore have no undesirable side effects. They eliminate wound bacteria solely by hydrophobic interaction.***

Wound infections – a cause for concern with serious consequences

Wound infections are often a serious complication. They can cause repeated operations for the patient, prolong scheduled hospitalization and lead to considerable extra costs.

The sooner an infection is diagnosed, the better the prospects for its timely and rapid control. Classical signs of infection include redness, swelling, hyperthermia, pain and functional impairment. The general symptoms such as fever, chills and elevated inflammatory parameters, like leukocytosis and CRP as well as swelling of the regional lymph nodes, are also definite signs of an infectious process.

Recognizing incipient wound infections is difficult, however, since the conclusive symptoms are often absent.

Table 1:
Types of infection
In wound infections, several types of bacteria usually are simultaneously active. The appearance of the infection shows whether it is primarily a

- pyogenic wound infection caused by pus-forming organisms
- wound infection induced by putrefactive bacteria
  or
- anaerobic wound infection caused by anaerobes

Table 2:
Precipitating factors of wound infection
The mere presence of bacteria does not automatically mean that a wound infection will develop. Several additional factors also have to be present. The following aspects are also important:

- the number of microorganisms present,
- the type of bacteria,
- the toxicity level (virulence) of the microbes,
- the type of wound (e.g. gaping or smooth), necrotic (covered with dead tissue) or fresh,
- whether foreign bodies are present in the wound,
- how well the patient's immune defence is functioning.

Thus, microbiological studies have shown that 10^5 pyogenic streptococci per cm^3 are sufficient to induce a wound infection.

A correct wound swabbing technique is essential for reliably estimating microbial contamination. Swabs should be taken from deep inside the wound and from the wound margins, which is where the infectious pathogens are concentrated.

Infections themselves are complex processes influenced by many factors (Table 1, Table 2), the etiology and age of the wound being especially important. Postoperative wounds, for example, require a different approach to traumatic or secondary healing wounds. Especially in poorly healing wounds, the blood perfusion conditions are a critical factor. The cells and substances important


Fig. A: Posttraumatic wound infection


Fig. B: Posttraumatic wound infection

for local immune defence and antibody production require oxygen which can only be provided in sufficient amounts in well-perfused tissue. From this it can be concluded that reduced or absent blood perfusion markedly increases the risk of infection.

Deficient blood perfusion can also lead to the formation of necrotic tissue, which itself is an ideal nutrient substrate for bacteria. Furthermore, a close relationship exists between the state of the wound and the patient's immune defences. An already weakened immune status, a generally debilitated condition, malignant tumours, certain metabolic diseases, advanced age and dietary deficiencies may be expected to have adverse effects on the immune response.

Prevention and treatment of infected wounds and wounds at risk of infection

Traumatic wounds are always subject to a greater or lesser extent of contamination with microorganisms. Especially superficial abrasions, lacerations and contusions require not only extensive disinfection and possibly surgical treatment, but also a suitable wound dressing with decontaminating and bacteria eliminating properties. Topical antibiotics should be avoided. Antiseptic solutions may be suitable but have only short-term bactericidal action. Wound covers and dressing materials which release their active ingredient over a prolonged period (at least 24 hours), or wound dressings with a bacteria-binding surface structure are therefore recommended. These materials should not adhere to the wound and should remove atraumatically at every dressing change.

With the declared aim of rapid microbial reduction in already infected wounds, surgical revision, if necessary, should be followed by disinfection either simultaneously with systemic antibiotic therapy or, if the patient's overall clinical condition is suitably good, possibly alone. Wound irrigation can be carried out additionally. The primary dressing should ideally have prolonged antibacterial efficacy and reliably cover the period until the next dressing change. Wound dressings saturated with antiseptic solutions or ointments are in our experience unsuitable, since they very often adhere to the wound bed and wound margins, cause considerable pain and retraumatize the wound when removed.

Postoperative infections, apart from the risks they involve for the patient, also lead to expensive prolongation of hospitalization. 2 to 5 per cent of all extra abdominal and another 20 per cent of all abdominal surgical operations are followed by postoperative disorders of wound healing. The patients concerned require intensive care 60 per cent more frequently, and hospital readmission five times as often, and the mortality in this patient population is approximately doubled. Major emphasis therefore also has to be placed on postoperative wound management.

Fig. C: Postoperative disorder of wound healing after heart bypass operation, surgical revision and rectal muscle flap plasty

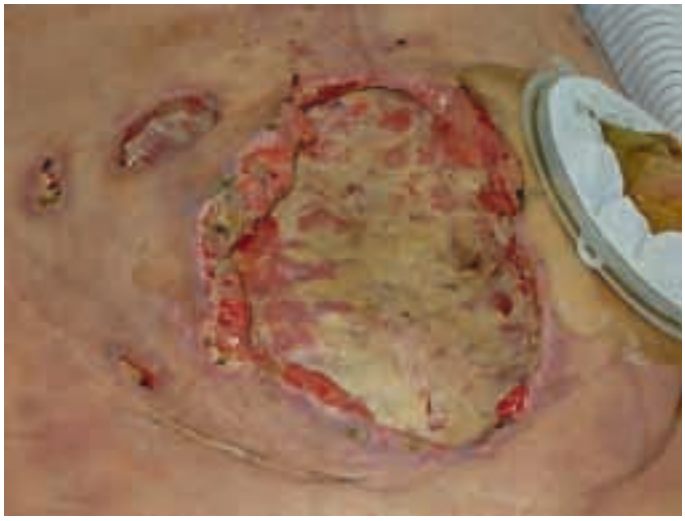


Fig. D: Postoperative disorder of wound healing after rectum resection

Delayed wound healing is often caused by more or less severe microbial colonization. A large number of scientific studies have shown that a high microbial count in a chronic wound is responsible for the very slow healing rate of these wounds. A microbial burden of more than 10^5 bacteria per gram tissue is already thought to impair wound healing. Here too, a surgical procedure and continuous bacteriostatic/antiseptic therapy are necessary until an infection-free and granulating wound develops.

Fig. E: Status post lacerated wound of the head and infection with scalp phlegmon

Resistances

The frequent use of antibiotics has led to some types of bacteria developing antibiotic resistance. The two most important resistant bacteria that play a major role in wound management are the methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin resistant Enterococcus (VRE). In some cases, no effective antibiotic is available any longer, since MRSA, for example, are resistant not only to methicillin but also to bacitracin, erythromycin, gentamicin, penicillins, tetracyclines, ciprofloxacin, kanamycin and rifampicin.
This is why wounds colonized with MRSA are usually treated with topical antiseptics.

Cutisorb® Sorbact® – properties and mechanism of action

Cutisorb® Sorbact® effectively binds and removes bacteria and other microorganisms from exudating unclean, contaminated or infected wounds. The dressing is made of textile fabric esterified with the highly hydrophobic substance dialkylcarbamoyl chloride (DACC) which makes it capable of binding microorganisms.

The Sorbact® method is based on the purely physical effect of hydrophobic (water-repellent) interaction, i.e. on the fact that hydrophobic substances cumulate together in an aqueous environment. Since most pathogenic microorganisms that impair wound healing, such as bacteria like Staphylococcus aureus, streptococci, E. coli and Pseudomonas as well as fungi such as Candida albicans have hydrophobic properties, they bind rapidly and efficiently to Cutisorb® Sorbact®.

This product is not associated either with undesirable effects or risks of cytotoxic, allergic or other intolerability reactions. Since its action is based exclusively on the physical effect, there is also no risk of inducing or exacerbating resistance formation in organisms.
While Cutisorb® Sorbact® compresses and swabs are made of impregnated acetate fabric, the absorbent pads also have an absorbent layer of cellulose. The ribbon gauzes are made from impregnated cotton fabric.

Table 3:
Indications and uses

- wounds with heavy bacterial contamination
- wounds at risk of infection
- infected wounds
  for example:
  - traumatic infected wounds
  - post-operative secondary healing wounds (abdominal wall abscess, pilonidal sinus, after abscess indisions)

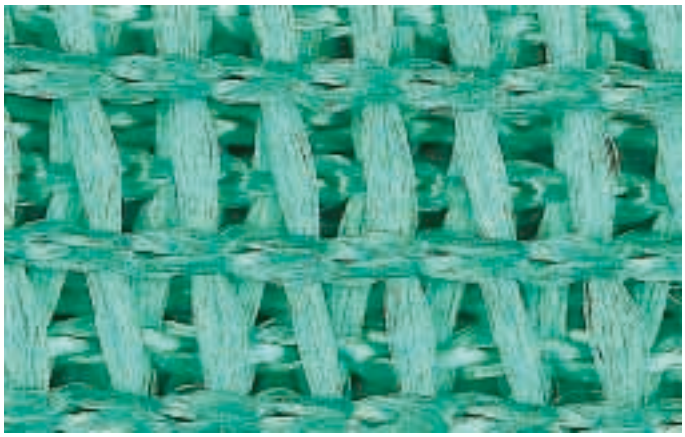


Fig.: F: The coating of Cutisorb® Sorbact® with dialkylcarbamoyl chloride (DACC) gives the dressings their hydrophobic properties

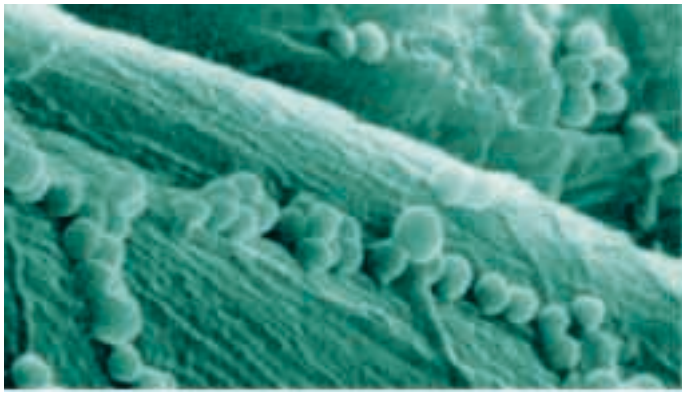
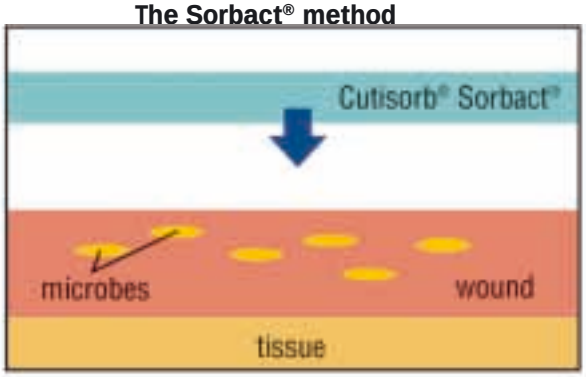


Fig. G: Staphylococcus aureus bound to Cutisorb® Sorbact® fibres (magnification x 3000)

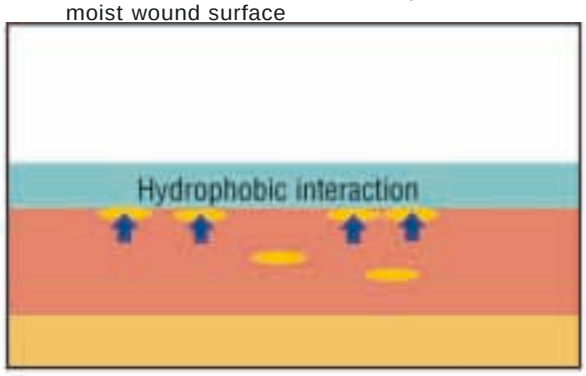
Results of a field test with Cutisorb® Sorbact®

A field test was performed with the bacteria binding wound dressing Cutisorb® Sorbact® (BSN medical GmbH & Co. KG) between June 2003 and December 2003 in a total of 36 patients with infectious and secondary healing wounds. Cutisorb® Sorbact® was used in all 36

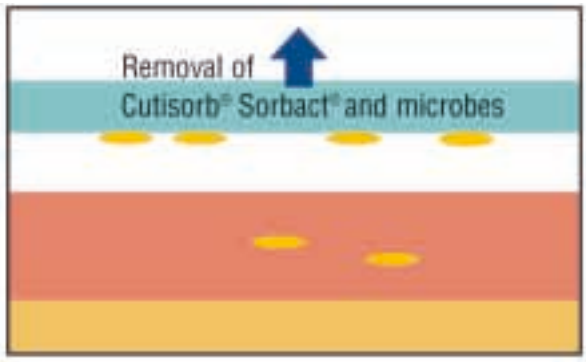
The Sorbact® method



Place Cutisorb® Sorbact® directly onto the moist wound surface



Following the natural law of hydrophobic interaction, the bacteria adhere to Cutisorb® Sorbact®



By changing the dressing, bound bacteria are expelled from the wound

patients on the first day of treatment or postoperatively, for example following pilonidal sinus excision or open amputation. No antiseptic solutions or ointments were used. Surgical debridement and irrigation with Ringer's solution was only performed if necessary.

The hydrophobic dressing was secured directly on the wound or placed as a tamponade in wound cavities. The swabs and tamponades were secondarily covered with an absorbent compress or a hydroactive dressing.The swabs taken at the start of treatment revealed the presence of bacteria such as: Staphylococcus aureus, Pseudomonas, Staph. coag. neg., β-hemolyzing streptococci, Enterococcus faecalis, E. coli and Klebsiella oxytoca.

The dressing was changed daily in the initial phase and then every two days after 2-4 days of treatment. After the wound conditions markedly improved and the signs of infection had completely subsided, the usual methods of moist wound treatment were applied after an average 8 to 10 days. Except in two cases, no systemic antibiotic therapy was required.

Dressings were changed initially after 24 hours, taking care to ensure that the swabs were positioned in their ready-made multi-layered form on the wound in order to ensure sufficient absorbent capacity. In 25 cases the swab was covered with Cutisorb® Sorbact® absorbent pad, so that wound exudate was optimally removed from the direct area of the wound into the absorbent layers. For two patients with vulva/labial abscess, the tamponades were placed deep inside the wound cavities. Although further wound coverage was not possible for anatomical reasons, the wound status was nevertheless seen to improve very rapidly. The treatment was continued for ten weeks as a preventive measure. Marked progress was observed in granulation and epithelization. No allergies or other complications occurred. The patients were grateful for the painless dressing change, since Cutisorb® Sorbact® did not adhere to the wound surface and could always be removed without problems.

Guidance for the effective use of Cutisorb® Sorbact®

When using Cutisorb® Sorbact® it is important to ensure that no greasy or oily substances (cream, ointments or oils) are applied simultaneously. The effectiveness of the material would be affected since these substances impair the mechanism of the hydrophobic interaction.

Because of the hydrophobic properties it is somewhat difficult to moisten Cutisorb® Sorbact® with Ringer's or saline solution e.g. for application in deep cavity wounds. The hydrophobic dressings can also be used without problems for microbial reduction under hydroactive dressings e.g. hydrocolloids or polyurethane foam dressings. As soon as the infection has subsided, treatment is continued with the usual moist wound treatment methods.

Summary

We observed a reduction of infection in all patients, associated with a marked improvement in wound status. Painless, atraumatic dressing change and the active ingredient-free variant of anti-infectious therapy provided a positive outcome. All currently available substances such as polyhexanide, octenidine, PVP iodine and silver-containing products are effective microbial reducing products but are not completely free of undesirable effects.

Cutisorb® Sorbact® is thus a product which can replace other tamponades in traumatic and postoperative applications, and especially after abscess incisions, coccygeal and anal fistula excisions, burst abdomen.

Case report I

Wound revision after complete separation of the dermis following roll-over injury to the lower leg

Diagnoses:
- Dislocated right subtrochanteric fracture of femur
- Third degree open lower leg fracture with right-side complete separation of the dermis
- Status post perinatal hypoxic brain damage

Medical history:
The patient was pressed against the wall by a forklift truck and sustained the above injuries. The patient is known to be mentally deficient due to perinatal hypoxic brain damage. For the same reason the patient had also suffered since birth from facial paresis with consecutive speech disorder.

Treatment and course:
First the femoral fracture was openly repositioned and fixated with a six-hole DCS plate. The lower leg was also openly repositioned and stabilized with a unilateral fixateur. This was followed by thorough wound débridement. With daily antiseptic dressing changes, further skin, fatty tissue and muscle necroses developed which were removed radically in a further operation.

Doppler sonography of the leg arteries revealed no evidence of stenoses and radiographic follow-ups revealed axial alignment of the fractures. Despite intensive antiseptic therapy, wound conditions persisted with poorly perfused granulation tissue, incipient contracture at the knee joint and equinus position of the foot. Amputation of the upper leg was discussed but was then deferred up to the present time (eight weeks after the accident).

For wound treatment, physical wound cleansing was performed with Cutisorb® Sorbact® for preparation for mesh skin transplantation. With daily wound treatment accompanied by surgical debridement under EMLA cream, we observed infection-free wound conditions after only six days and well perfused and granulated tissue. Mesh skin transplantation was performed four days later. After the first few dressing changes it was found that about 70 % of the graft had taken. With application of hydroactive dressings and lipocolloid wound dressings, the remaining wound areas rapidly epithelized. The patient was transferred at her ownrequest to a suitable facility for rehabilitation.

Fig. 1: Wound status on first postoperative day after surgical removal of necrotic tissue. Further black necroses are present in the middle and at the margin of the wound

Fig. 2: After surgical débridement under EMLA cream, a necrosis-free wound is obtained

Fig. 3: Cutisorb® Sorbact® swabs are placed on the wound surface, covered with Cutisorb® Sorbact® absorbent pads and fixed with gauze bandages. This treatment was performed for ten days and was followed by wound bed conditioning with synthetic skin replacement and on the 13th day mesh graft skin transplantation under anesthesia

Fig. 4: On the 5th postoperative day, about 70 % of the graft was found to have taken. The open areas were treated partially with hydroactive dressings and partially with lipocolloid wound dressings

Fig. 5: Wound status on 20th postoperative day: progressive epithelization

Fig. 6: The wound is almost completely epithelized after 50 days

Case report II

Open wound treatment after incision of a labial abscess

Diagnoses:
- Left-sided labial abscess
- Diabetes mellitus, insulin-dependent, poorly controlled
- Hyperuricemia

Medical history:
This 50-year-old patient developed a large abscess of the left labia within 14 days. Initial application of antiseptic dressings to the skin provided no improvement. The existing diabetes mellitus type IIb became decompensated with values of 450 mg/dl on admission. The patient was admitted as an emergency to the medical clinic for intensive medical supervision.

Treatment and course:
The gynecologist was consulted and on the next day an abscess incision was performed under anesthesia on the left labia, starting almost at the pubic bone and extending into the perineal region. Intraoperatively, only a moderately large amount of liquid and pus was drained. A bacteriological swab was taken. The existing fatty tissue necroses were removed, in some cases as far as the bone. Insertion of an antiseptic tamponade. Further removal of necrotic tissue was planned, and systemic antibiotic therapy was initiated.

On the first postoperative day the tamponade was removed and a new tamponade inserted. Surgical wound revision under anesthesia and placement of a vacuum seal was planned for the next day. Within six days the vacuum seal was renewed every second day and necrotic tissue removed. The wound was increasingly cleansed with this therapy, allowing us to switch to local, physical antibacterial therapy with Cutisorb® Sorbact® tamponade (two ribbon gauzes measuring 5 cm x 200 cm). Wound pads were used for coverage. Daily wound treatment was possible without anesthesia, since the material did not adhere to the wound margins and removed atraumatically.

During the further course the wound granulated well and steadily decreased in size. The patient was discharged to her primary care physician after a 4-week stay in hospital. Seven weeks after the abscess incision, secondary suturing was performed in infection-free wound conditions. The entire period of wound treatment was carried out using only Cutisorb® Sorbact®. We observed no complications, especially no allergic reactions.

Fig. 1: Wound status after lancing of abscess, before second surgical débridement and vacuum sealing

Fig. 2: Operative site, removal of skin and fatty tissue necroses

Fig. 3: Infection-free and granulating wound on day 22 of treatment

Fig. 4: Cutisorb® Sorbact® ribbon gauzes are inserted

Fig. 5: Wound status on day 25 of treatment, immediately before secondary suturing.

Fig. 6: Staus after surgical closure

Case report III

Secondary wound healing after coccygeal fistula excision

Diagnosis:
- Chronic pilonidal sinus

Medical history:
This 19-year-old patient had a recurrent swelling in the anal cleft for four weeks. Pus was drained on exertion of pressure. Local therapy had produced no success.

Treatment and course:
An outpatient operation was performed with excision of the affected tissue from the skin and subcutis down to the healthy fatty tissue without primary wound closure. The open wound treatment, initially for four days, was performed with Cutisorb® Sorbact® and then with hydroactive foam dressings until complete healing after four weeks. Wound healing was uncomplicated.

Fig. 1: Wound status on first postoperative day. At the top of the wound can be seen superficial necroses caused by electrocoagulation

Fig. 2: Continuation of daily wound treatment

Fig. 3: After wound cleansing, a Cutisorb® Sorbact® tamponade was inserted

Fig. 4: Cutisorb® Sorbact® absorbent pad used as secondary wound dressing

Fig. 5: Wound status after seven days with infection-free granulating wound conditions. Now changeover to moist wound treatment with hydroactive dressings

Fig. 6: On day 25 of treatment, the wound has already closed to an extent of 50 %. Dressing change intervals every 3 to 4 days until healing is complete

Fig. 7: Result of wound treatment, picture taken after 12 weeks

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