
THE EFFECTIVENESS OF CERAMICS FOR TREATMENT OF DIABETIC FOOT ULCERS INFECTED WITH MDR (MULTI DRUG RESISTANT) BACTERIA

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Abstract

Background:

Infected foot ulcers precede about two-thirds of lower extremity amputations. Foot ulcers are now the most common diabetes related cause of hospitalization and are frequent precursors of amputations. As many of these ulcers are hard to heal, a number of novel wound treatment devices are now available to help heal them. One such product is the CERDAK BIOCERAMIC WTD. It consists of sachets filled with sterile ceramic spheres with an average diameter of 0.7mm. They generate capillary suction forces which absorb wound exudate along with bacteria. These waste products are separated from the wound and the formation of healthy granulation tissue is promoted at a faster rate.

Study design:

Observational study including four patients with Type 2 diabetes mellitus on insulin therapy, treated in our institution. The patients had grade 3B or higher ulcers over the plantar surface of the foot (University of Texas ulcer classification).

All patients underwent debridement and tissue culture and showed the presence of multi drug resistant gram negative bacilli at the time of debridement, which were ESBL positive (extended spectrum beta lactamase positive).

The debrided wounds were treated with Cerdak wound treatment devices locally and with appropriate culture sensitive antibiotics, except in one patient where the patient was not able to afford treatment with the appropriate antibiotic because of its high cost.

Results:

- Repeat wound cultures taken over the next week were negative for MDR bacteria.
- The wounds in all four patients showed good granulation tissue formation and were later grafted with SSG's.
- All four ulcers healed within two months.

Conclusion:

The case studies show that the CERDAK BIOCERAMIC WTD can be an effective weapon in the

armamentarium against multi drug bacteria found in diabetic foot wounds when used in conjunction with good clinical practices, inclusive of good glycaemic control and offloading of the ulcer. Further research in this direction may be needed to define its role fully, as it has a unique mode of action (capillary action which physically removes the bacteria and exudates), which prevents development of bacterial resistance against bioceramics.

“Cerdak can be an effective weapon against multi drug-resistant bacteria found in diabetic foot wounds”

Description of cases

Case I

Mrs. R, aged 60, was admitted with a plantar abscess which developed after she had walked barefoot on a pilgrimage.

Her HbA_{1c} was 10, FBS was 424mg/dl and her Total Leucocyte Count (TLC) was 28,000 at the time of her admission. She was initially debrided and about 50ml of pus was let out. As there was deterioration of her condition with involvement of the 3rd and 4th layer of muscles in the foot she underwent a repeat debridement 4 days later. All necrotic muscle was removed. Tissue culture showed that she was infected with ESBL positive *Pseudomonas aeruginosa* which was resistant to all antibiotics except imipenem and meropenem. As her financial condition did not permit us to use these antibiotics she was put on Inj Chloramphenicol while monitoring her blood counts. As there was minimal granulation tissue and lots of exudate, even after 4 days post op, it was decided to use Cerdak cavity. After the first application of Cerdak cavity, there seemed to be a marked reduction in the exudate produced by the wound. Very soon the wound

started to granulate vigorously and by day 30 was free from slough. Repeat cultures done in the 2nd week were negative for the MDR bacteria. The patient underwent SSG on day 33 and was given suitable footwear.



Day 1



Day 4



Day 5 (Cerdak Cavity Dressing in place)



Day 15



Day 25



Day 40

Case II

Mr. K, aged 81, diabetic and on insulin therapy for the past 40 years, presented with a three month old ulcer over the right heel. The ulcer was 10 X 15 cm in size and was probing to calcaneum. The calcaneum was necrotic in some areas. He also had POVD (Ankle Brachial index was 0.56). He is a smoker and had borderline diabetic nephropathy. He also had bilateral foot drop due to bilateral common peroneal nerve palsy. The ulcer showed lots of slough. His FBS was 345mg/dl and his TLC was 19,000 at the time of admission. As the vessels were not revascularisable he was advised a below knee amputation at another hospital. The ulcer was thoroughly debrided and the

calcaneum was curetted to healthy bone. Tissue culture showed ESBL producing *Pseudomonas aeruginosa* sensitive to meropenem and piperacillin/tazobactam. He was put on parenteral Piperacillin/tazobactam along with local application of Cerdak WTD's. His heel was offloaded. By day 6 the production of exudate had reduced and the ulcer showed some sprouting granulation tissue. Repeat culture done after 15 days showed no growth. The ulcer improved and was grafted after six weeks of treatment. Now the ulcer has healed and the patient is being mobilized in a moulded shoe with AFO.



Day 1



Day 10



Day 35



Day 45



Day 60

Case III

Mr. M, aged 62, a diabetic for the past 25 years with CAD, CRF, old stroke and dyslipidemia was admitted with gangrene of his left 3rd toe with plantar space abscess. His FBS at time of admission was 382mg/dl and his HbA_{1c} was 8.5. TLC at that time was 15,000.

The infection had spread to his 1st 2nd and 3rd metatarsophalangeal joints. A transmetatarsal amputation with sloughectomy was done. Tissue culture showed ESBL positive MDR E.coli along with coagulase negative Staphylococcus. He was put on culture sensitive antibiotics. His wound was looking pale over the first 4 days in spite of a haemoglobin of 12gms/dl, after which Cerdak dressings were applied. The ulcer started to granulate slowly. Repeat cultures done after two weeks were negative. The ulcer became fit for SSG after 5 weeks and SSG was done. Patient is now ambulant with appropriate footwear.



Day 1



Day 6



Day 22



Day 35



Day 50

Case IV

Mrs.K, aged 53, diabetic for the past 17 years and on insulin therapy, was admitted with an infected ulcer over her right 5th toe which was probing to bone with osteomyelitis of the proximal phalanx of the 5th toe with a plantar space abscess. Her FBS was 290mg/dl and TLC was 22,000 and HbA_{1c} was 9.5 at the time of her admission. The infection had spread to the dorsum of her foot along the 1st webspace and she was advised a transmetatarsal amputation. As patient did not consent for the same, a 5th toe amputation with

sloughectomy was done. Tissue culture showed the presence of Klebsiella pneumoniae which was ESBL positive and resistant to routine antibiotics. Methicillin sensitive Staphylococcus aureus was also cultured along with Klebsiella. The patient was started on appropriate antibiotics and Cerdak dressings were applied. Exudate started to decrease soon after and the wound started to granulate after a week. Repeat cultures done after 10 days came back as negative. The patient underwent SSG during the 7th week and is now being mobilized with custom made shoes.

Case IV



On admission



Week 3



Week 5



Week 9

Discussion:

Characteristics of an ideal wound dressing¹

- Maintains a moist wound environment
- Absorbs excess exudate
- Eliminates dead space
- Does not harm the wound
- Provides thermal insulation
- Provides a bacterial barrier

The effect of a moist environment and the removal of excess exudate on chronic wound healing further lead to:

- Less intense & less prolonged inflammation²
- More rapid keratinocyte proliferation³ and migration⁴
- Earlier differentiates of keratinocytes to restore cutaneous barrier function⁵
- Increased fibroblast proliferation⁶

- Increased collagen synthesis⁷
- Earlier full thickness wound contraction⁸

In measuring the clinical observations of Cerdak against the above mentioned published clinical outcomes Cerdak seems to fit the profile of an “ideal dressing”.

We have observed slimy layer over the wound during dressing changes, which could indicate a thin layer of fresh exudates on the wound bed.

In summary

- The bioceramic dressing removes excess exudate.
- It promotes healthy granulation tissue formation.
- It is easy to apply.
- It is cost-effective, even in the Indian health care environment.
- Does not need frequent changes.

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