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Clinical report

Surgical Maggots

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Surgical maggots have been used successfully for wound debridement over the past millennium. At Johns Hopkins University in 1929, Baer introduced maggots into the wounds of 21 patients with chronic intractable osteomyelitis. The development of methicillin-resistant *Staphlococcus aureus* has been a major impetus to resurgent interest in maggot debridement. In January of 2004, the US Food and Drug Administration gave Dr. Ronald Sherman permission to produce and market surgical maggots for debriding non-healing necrotic skin and soft tissue wounds.

Given an uncooperative patient with non-healing wounds, our medical team obtained insectary-reared sterile surgical maggots, *Phaenicia sericata,* to promote debridement of necrotic tissue and development of granulation tissue.

Keywords: Maggot debridement, surgical maggots, *Phaenicia sericata,* pyoderma gangrenosum.

Surgical maggots have been used successfully for wound debridement over the past millennium [1, 2]. Evidence suggests that ancient Mayans, as a means of attracting maggot strikes, soaked dressings in cattle blood and applied them to their own wounds [3]. War was the background against which maggot therapy arose. In 1559, Pare noted the beneficial effects of maggots on combat trauma in the battlefield [4]. The first documented application of maggots was by John Zacharias, a surgeon in the American civil war as follows: *"During my service in the hospital at Danville, Virginia, I first used maggots to remove the decayed tissue in hospital gangrene and with eminent satisfaction. In a single day, they would clean a wound much better than any agents we had at our command. I used them afterwards at various places. I am sure I saved many lives by their use, escaped septicaemia, and had rapid recoveries"* [5].

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William S. Baer may be considered the father of biomedical debridement as a clinical tool against wound sepsis. A military surgeon in France in 1917, Baer was impressed by the remarkable healing of compound fractures of the femur and large, seemingly unsurvivable abdominal wounds in a soldier left unattended for several days without food or water. Although his wounds were covered with thousands of maggots, the patient was afebrile, no bare bone was seen, and healthy granulation tissue surrounded the traumatized tissues. At Johns Hopkins University in 1929, Baer introduced maggots into the wounds of 21 patients with chronic intractable osteomyelitis. All open lesions completely healed and all patients were discharged well after two months of therapy [6]. Following a period of considerable interest in the 1930's and 1940's, attention waned with the appearance of antibiotics. Now, the development of methicillin-resistant *Staphlococcus aureus* has been a major impetus to resurgent interest in maggot debridement [7]. In January of 2004, the US Food and Drug Administration gave Dr. Ronald Sherman permission to produce and market surgical maggots for debriding non-healing necrotic skin and soft tissue wounds. In the past decade, Sherman, his colleagues, and others have put maggot therapy on a solid footing of evidence-

based medicine, by rigorous clinical trials in the treatment of osteomyelitis [8], pressure ulcers in spinal cord injury patients [9], venous stasis ulcers [10], foot and leg wounds [11], and diabetic foot ulcers unresponsive to conventional therapy [12].

As described by Sherman [13], disinfected larvae, about 2 mm in length, are applied to a wound a density of 5-8/cm^2 and then covered with a hydrocolloid pad (Douderm, Convatec, Princeton, NJ, USA). A hole is cut to match the dimensions of the wound to create a dam which prevents maggots or necrotic drainage from reaching the surrounding skin. A porous sheet of chiffon or nylon is glued to the ring, creating a cage which allows flow of air. The porous sheet is in turn covered with a light gauze pad which quickly becomes soiled and must be replaced lest the maggots drown. The cage and maggots may remain in place for 48 hours. Two 48-hour cycles are applied each week and gauze, moistened with saline or 0.125% sodium hypochlorite, is applied between cycles. Maggots easily fall away with removal of the gauze or a saline rinse [13]. Disinfected *Phaenicia sericata* larvae were obtained from Monarch Labs (Irvine, CA, USA; *www.MonarchLabs.com*), the exclusive supplier in the United States.

More than 800 health care facilities have used this source and maggots are available by prescription only. There is apparently no available literature in the West about the application of maggot therapy in Asia. None of our colleague from Thailand, Myanmar, or Vietnam is aware of maggot therapy in their countries. There may be a need for local clinicians to start their own insectaries in Asia.

Case report

A 51 year old white female presented with a six month history of multiple subcutaneous nodules that had expanded into necrotic ulcers, which enveloped a large portion of her hips and lower extremities. A yellow malodorous fluid emanated from the ulcers. In addition to her acute complaint, the patient had an extensive history of tobacco abuse, end-stage renal disease, refractory anemia, hypertension, severe mitral regurgitation with suspected endocarditis, chronic obstructive pulmonary disease, and status post-cholecystectomy, which complicated the treatment regimen.

Based on the history, which of the following is the most likely cause of the patient's ulcer (see **Table 1**):

A. Panniculitis,
B. Pyoderma gangrenosum,
C. Septic emboli,
D. Cryoglobulinemia,
E. Decubitus pressure ulcer.

Surgical pathology revealed dermal fibrosis with edema extending deeply into the subcutaneous fat but without definite vasculitis, microthrombi, calcium or evidence of calciphylaxis. Isolates included *Enterococcus faecalis, Stenotrophomonas maltophilia, Trichosporon beigelii, Pseudomonas, Klebsiella, Enterococcus faecalis,* diphtheroids and an unidentifiable Gram negative rod. Our working diagnosis was pyoderma gangrenosum with secondary polymicrobial colonization and infection.

Table 1. Selected differential diagnosis of necrotic ulcer.

Condition	Characteristics
Panniculitis	Hallmark is inflammation of muscle and subcutaneous fat. Presentation includes constitutional symptoms (e.g., weight loss and fatigue) and tender nodules.
Septic Emboli	
Pyoderma Gangrenosum	Neutrophil dysfunction leading to the development papules that can become large, necrotic ulcers. Associated with autoimmune diseases including Crohn's disease.
Cryoglobulinemia	
Decubitus pressure ulcer	Stage I ulcers are nonblanchable erythematous lesions of the epidermis without damage to deeper layers. Stage II ulcers extend into the dermis and their depth is usually confined to a few millimeters. Stage III ulcers are full-thickness lesions which involve the dermis. These lesions can be extensive and involve subcutaneous fat. Stage IV ulcerations expose muscle, tendon, or bone*. (*This staging system for ulcers should NOT be used if eschars or blisters are present).

The patient's history of self-neglect and her refusal to change dressing or use pulse water wound care created a dilemma for the care of her poorly-healing wounds. Left with an intractable wound, the medical team obtained insectary-reared sterile surgical maggots, *Phaenicia sericata*, from a commercial source and applied to the ulcer. She was able to tolerate only two and one half of the recommended six cycles but, in spite of her severe co-morbidities and aggressive necrotic process, there was some reduction of necrotic tissue and promotion of granulation tissue (**Fig. 1**). Unfortunately, despite the improvement, multiple systemic antibiotics, Amphotericin B, and hydrocortisone, the patient ultimately succumbed to the overwhelming infection. Her cause of death is listed as septic shock.

Surgical maggots improve tissue oxygenation [13] and their secretions appear to amplify the wound-healing effects of host epidermal growth factor and IL-6, as well as to stimulate the growth of human fibroblasts and slow-growing chondrocytes. Their secretions are bactericidal against methicillin resistant *Staphlococcus aureus* and other bacteria *in vitro* [14]. Healthy tissue is scrupulously avoided and there is no burrowing behavior. In comparison to conventional treatments, maggot-treated pressure ulcers of 103 patients were debrided two-four times faster, were twice as likely to decrease in size and were twice as likely to heal [15]. A tickling sensation is typical but the vast majority of patients are surprisingly receptive and quite gratified by the results. During treatment, the ulcer should be well oxygenated and allowed to drain freely. Care should be taken to avoid over-usage, desiccation, drowning or crushing of the larvae. Use is contraindicated near damaged vessels and tracheotomies [16].

The authors have no conflict of interest to report.

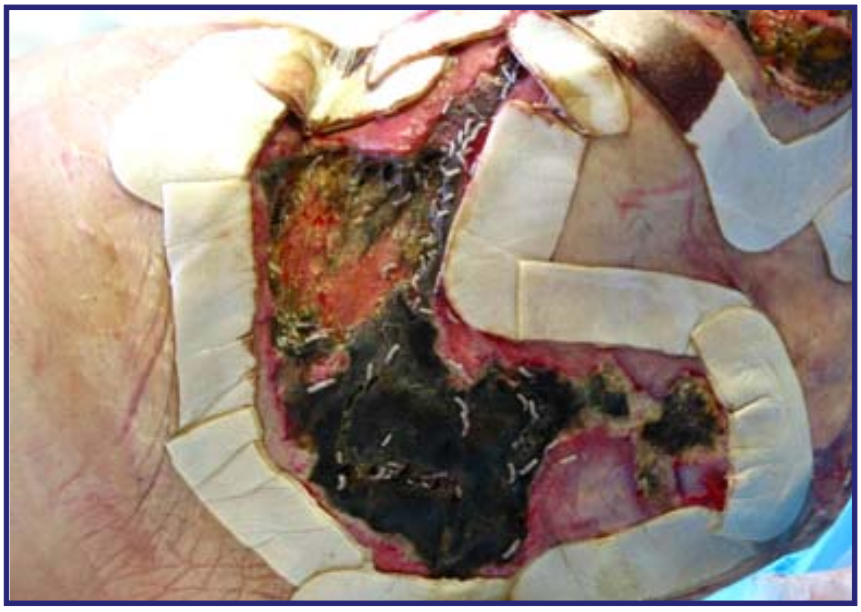

Fig. 1 Surgical maggots, surrounded by a hydrocolloid dam, debride a poorly-healing, polymicrobial ulcer on the right hip at end of second treatment cycle, 72 hours post-application.

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